SCIENCE

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VOLUME 115 NUMBER 2995

Contents

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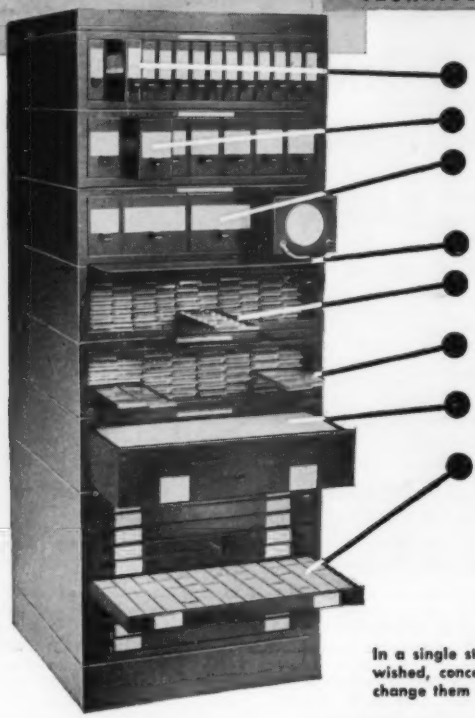

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Atmospheric Pollution

HISTORICALLY the terms air pollution and smoke pollution were synonymous. Submicron size particulate matter emitted from fuel-fired combustion unit chimneys was recognized as a necessary evil and accepted as an adjunct of urban living in London three centuries ago. Carbonaceous material was not the only substance emitted, nor was the form always particulate. Only a few scientific reports of investigations concerned with atmospheric pollution appeared in literature of the nineteenth century, but since 1900 a growing interest has been evident.

Recent progress of inquiry into the causes of atmospheric pollution and concomitant investigation of means of controlling air-contaminant concentrations have demonstrated a fact of considerable scientific importance. Many professional interests are searching concurrently for basic information.

Engineers, chemists, physicians, toxicologists, biologists, meteorologists, bacteriologists, and physicists have each discovered variables that affected the soundness of their own initial conclusions. Each has found it necessary to turn to specialists in other sciences for assistance in verifying data required for the formulation of empirical approaches and for explanations pertinent to fundamental advances in theory.

Individuals engaged in many different occupations find that they are faced with problems of air pollution. Executives, administrators, managers, industrial research staffs, public health officials, consulting firms, equipment manufacturers, and engineers of the several branches—particularly sanitary, chemical, and mechanical—are forced to cope with individual atmospheric waste collection and disposal situations. Pollution may be localized to industrial premises or may be extended to neighborhood, community, or region.

Atmospheric pollution has today become a major challenge to scientists, to administrative officials, and to the public. Several important meetings have been held or are scheduled for the first half of 1952. These include scientific meetings, industrial conferences, public gatherings, and official agency sessions offering information about air pollution, its effects, and its control.

University, foundation, and industrial centers of research are devoting more time to fundamental investigations. As one example, Gordon H. Strom and his staff, who are working with wind tunnels at New York University (College of Engineering), are venturing into a relatively unexplored field by investigating the effect of temperature gradient on atmospheric turbulence in scale models. Current meteorological field studies at Brookhaven National Laboratory and other comparable research will add knowledge of many characteristics of the atmosphere that will be correlated with Dr. Strom's studies.

As may frequently occur when scientific investigations overlap, or when professional and technical viewpoints are multiple, there are points of difference. Differences traceable to gaps and inadequacies in factual information can be resolved by research. Interpretation of information so that professions are attacking air pollution problems in unison requires compromise and patience, as well as recognition of the technical competence of others.

The past fifty years, and notably those following World War II, have witnessed a narrowing of both scientific and professional differences. The next ten years promise great scientific advancement in instrumentation for detection of contaminants; in techniques for studying dispersion characteristics; and in assessment of the effect of airborne substances on people, property, animals, and vegetation. Concurrently there should be swifter development of methods for the control of exhaust emission, for waste treatment, and for process-controlled reduction of any hazardous atmospheric pollutant.

Thus scientific and technological efforts are converging upon the solution of a problem of universal interest.

WILLIAM T. INGRAM

College of Engineering
New York University

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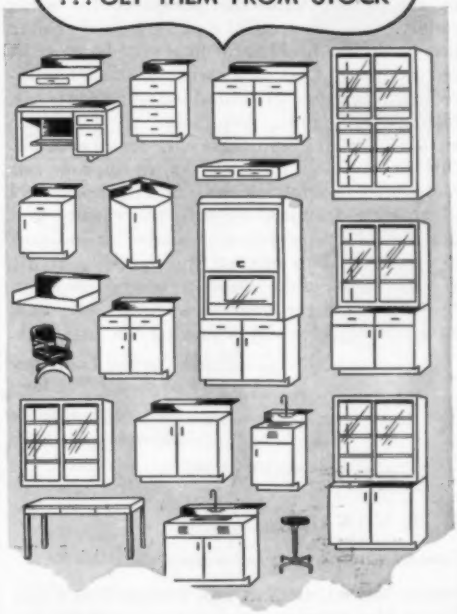

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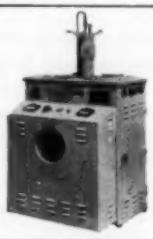

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History and Development of Chemical Periodicals in the Field of Analytical Chemistry: 1877–1950[1]

Fletcher S. Boig
Department of Chemistry, Northeastern University, Boston, Massachusetts
Paul W. Howerton
Julius Hyman and Company, Denver, Colorado

AS A SEQUEL TO A PREVIOUS STUDY,[2] in which periodicals in the field of organic chemistry were analyzed, the authors decided to investigate periodicals in the field of analytical chemistry. The data were collected from the Analytical Section of *Chemical Abstracts* for the years 1950, 1949, 1948, 1947, 1937, 1927, and 1917; and from the Analytical Section of *Chemisches Zentralblatt* for the years 1907, 1897, 1887, and 1877. The data for the year 1907 were taken from the latter rather than from *Chemical Abstracts*, because the latter was then in its first year of publication.

Collection of Data

Since the manner of collecting the data, including a discussion of the advantages and disadvantages, has been explained in detail elsewhere,[2] a brief summary of the method used will suffice here. The data included the name of the periodical, years in which it was published, country of publication, language of each article abstracted, total number of periodicals, and total number of abstracts by country and by language. Abstracts of obituary notices and polemic discussions were omitted from the count.

Arrangement of Data

The data have been assembled in five tables and are also illustrated by graphs, which indicate the situation very clearly. Table 1 lists the most heavily abstracted journals, their years of publication, number of abstracts from each journal in each of the years studied and their relative importance from a quantitative viewpoint and also the total number of contributing journals and total number of abstracts for each of the years studied. Table 2 gives an analysis of the number of abstracts by country of publication; and Table 3, by language of publication. Table 4 gives a breakdown in percentage of all abstracts by country; and Table 5, in percentage of all abstracts by language. Graphical representation of the data is shown in Figs. 1–5, from which the relationships can be easily seen.

[1] Presented before the Chemical Literature Division of the American Chemical Society, Boston, Mass., April 1951.
[2] F. S. Boig, and P. W. Howerton. *Science*, **115**, 25 (1952).

Interpretation of the Data

Table 1 shows that, of the first 16 journals in the analytical chemistry field in 1950, only the German *Zeitschrift fur analytische Chemie* and the *Bulletin de la société chimique de France* were among the leaders (first and seventh, respectively) in 1877. In 1887 *Analyst* of England became an important journal and has continued as such to the present day. Five of the first 16 journals in 1950 are newcomers—four of them Russian, and one Dutch.

The leading journal at present is the American *Analytical Chemistry*, which started in 1929 as the *Analytical Edition* of *Industrial and Engineering Chemistry*. Its new name was adopted in January 1947, and the journal has been in first place since 1947, though it was temporarily in first place in 1917. Second place at the present time is occupied by the Russian *Zavodskaya Laboratoriya*, which started in 1935 and was the leading journal in 1937. Since 1937, however, it has been a consistent second to *Analytical Chemistry*. Other leading Russian periodicals in this field include *Zhurnal Analiticheskoi Khimii*, which was started in 1946 and has moved into third place since that time; *Izvestiya Akademii Nauk SSSR*, started in 1925, and now in fifteenth place; *Izvestiya Sektora Platiny i Drugikh Blagorodnykh Metallov*, started in 1923, and now in sixteenth place. At present, the fourth ranking journal is a newcomer, *Analytica Chimica Acta* of Holland, which was started in 1947 and is published in several languages, including English, French, and German. Its growth has been very rapid.

The leading periodicals published in England include the fifth place *Analyst*, which was started in 1876, *Nature*, and *Metallurgia*. At the turn of the century important places were held by the *Journal of the Society of Chemical Industry*, which was founded in 1882, and by *Chemical News*, which started in 1859 and ceased publication in 1932. The leading journals of France at the present time are the sixth place *Bulletin de la société chimique de France* and *Chimie analytique* (formerly *Annales chimie analytique*) in twelfth place. In previous years *Comptes rendus* was a prominent contributor. The leading journals printing articles in the analytical field in other countries

TABLE 1

NUMBER OF ABSTRACTS BY PERIODICALS
(1877 to 1907 inclusive, *Chemisches Zentralblatt*)
(1917 to 1950 inclusive, *Chemical Abstracts*)

Journal	Country	1950		1949		1948		1947		1937		1927		1917		1907		1897		1887		1877	
		Position	No.	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.
Analytical Chemistry (1947–)*	USA	1	277	1	233	1	151	1	129	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Industrial and Eng. Chem. (1909–46)	USA	—	—	—	—	—	—	—	—	2	116	3	35	1	34	—	—	—	—	—	—	—	—
Zavodskaya Laboratoriya (1935–)	Russia	2	183	2	204	2	69	2	63	1	167	—	—	—	—	—	—	—	—	—	—	—	—
Zhurnal Anal. Khimii (1946–)	Russia	3	90	3	109	—	9	18	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Analytica Chimica Acta (1947–)	Holland	4	85	4	98	3	47	28	7	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Analyst (1876–)	England	5	76	5	64	6	35	4	49	5	37	2	39	12	8	17	19	20	10	14	15	—	0
Bull. soc. chim. France (1858–)	France	6	33	17	15	10	23	6	21	15	15	20	8	—	1	12	26	9	24	11	18	7	13
Chem. Listy (1907–), Listy Chem. (1875–91)†	Czechoslovakia	7	32	—	1	—	0	—	0	—	7	—	4	—	0	—	0	—	0	19	9	—	0
Mikrochem. ver. Mikrochim. Acta (1914–)‡	Austria	8	31	11	18	8	26	8	19	6/7	67	19	9	—	0	—	—	—	—	—	—	—	—
Zeitschrift analyt. Chemie (1862–)	Germany	9	31	6	35	4	41	—	0	3	114	1	101	5	15	5	38	8	26	1	51	1	62
Anales (real.) soc. espan. fis. y quim. (1902–)§	Spain	10	25	10	19	5	39	5	26	—	7	—	3	17	6	—	0	—	—	—	—	—	—
Nature (1869–)	England	11	23	14	17	—	12	26	7	—	1	—	1	—	0	—	0	—	0	—	0	—	0
Chim. Anal. (1919–), Ann. chim. anal. (1893–1919)‖	France	12	21	7	28	7	32	10	18	—	—	17	10	7	12	3	52	—	3	—	—	—	—
J. Assoc. Off. Agr. Chem. (1918–)	USA	13	17	8	24	—	9	30	7	16	15	16	11	—	3	—	—	—	—	—	—	—	—
Metallurgia	England	14	17	13	17	9	25	15	11	—	2	—	0	—	0	—	—	—	—	—	—	—	—
Izvestiya Akad. Nauk (1925–)	Russia	15	16	—	2	—	10	—	0	—	0	—	0	—	—	—	—	—	—	—	—	—	—
Izvestiya Sektora Platiny . . . (1923–)	Russia	16	16	—	0	—	0	—	2	—	—	—	0	—	—	—	—	—	—	—	—	—	—
J. Chem. Soc. Japan (1880–)	Japan	—	6	—	8	—	4	3	61	12	17	—	1	—	0	—	0	—	0	—	0	—	—
Comptes rendus (1835–)	France	—	10	18	15	13	15	9	19	18	13	12	13	14	7	13	25	3	40	15	15	4	23
Chemist-Analyst (1912–)	USA	—	13	—	9	—	11	11	16	10	22	10	13	3	21	—	—	—	—	—	—	—	—
Angew. Chemie¶	Germany	—	10	—	12	—	3	—	1	8	25	8	17	20	5	8	34	4	40	6	34	—	—
J. Applied Chem. USSR (1928–)	Russia	—	0	—	0	—	0	—	14	4	83	—	—	—	—	—	—	—	—	—	—	—	—
J. Am. Chem. Soc. (1876–)	USA	—	8	—	5	15	14	—	8	9	23	9	15	2	27	2	79	2	54	—	4	—	0
J. Chem. Education (1924–)	USA	—	0	—	12	16	13	—	8	17	14	—	3	—	—	—	—	—	—	—	—	—	—
J. Soc. Chem. Ind. (1882–)	England	—	0	12	17	12	20	—	4	13	17	—	4	6	14	10	28	6	34	8	22	—	0
Chem. Zeitung (1877–)	Germany	—	1	—	1	—	0	—	0	—	—	5	29	4	18	1	103	1	54	2	47	—	0
Pharm. Zentralhalle (1860–)	Germany	—	5	—	2	—	0	—	0	—	3	—	2	—	0	11	27	—	14	3	43	8	13
Chem. News (1859–1932)	England	—	—	—	—	—	—	—	—	—	—	—	2	10	9	—	15	12	21	4	36	3	30
Chem. Berichte (1945–), Berichte (1867–1945)**	Germany	—	0	—	1	—	0	—	0	—	7	11	13	—	4	15	23	—	14	10	19	2	39
Total abstracts			1710		1569		1106		961		1412		730		320		1201		771		680		301
Total journals																							

* *Analytical Chemistry* (1947) was previously known as *Industrial and Engineering Chemistry* (1909–47), *Analytical Edition*.
† *Chem. Listy* (1907–) may be a somewhat belated revision of *Listy Chem.*, published from 1875 to about 1891.
‡ *Mikrochemie* was combined with *Mikrochimica Acta* in 1937.
§ *Anales soc. espan. fis. y quim.* was changed about 1941 to *Anales real. soc. espan. fis. y quim.*
‖ *Annales chim. anal.* was changed in 1919 to *Chim. Anal.*
¶ *Angew. Chem.*, the present name, was formerly known as *Z. angew. Chem.* (1888–1932) and *Repertorium anal. Chem.* (1881–87).
** *Berichte* was changed in 1945 to *Chem. Berichte*.

TABLE 2

TABLE 2

Number of Abstracts by Country

Country	1950		1949		1948		1947		1937		1927		1917		1907		1897		1887		1877	
	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.
United States	1	437	1	362	1	279	1	254	3	246	2	116	1	132	3	129	4	68	5	31	6	5
Russia	2	345	2	356	4	102	2	113	1	353	7	22	—	2	10	6	7	18	8	13	—	1
England	3	174	3	151	3	127	3	105	4	88	4	79	3	43	4	97	3	79	2	82	3	39
France	4	113	6	119	2	145	4	102	5	87	3	83	4	28	2	216	2	146	3	71	2	52
Germany	5	110	4	121	5	83	6	51	2	269	1	269	2	70	1	589	1	370	1	393	1	175
Holland	6	94	5	120	6	65	8	23	—	14	5	26	5	17	6	37	9	8	—	2	—	—
Czechoslovakia	7	60	13	20	12	18	—	3	9	24	12	7	—	—	9	6	—	3	7	13	—	—
Austria	8	51	9	32	9	38	12	20	6	74	9	17	—	3	7	23	6	31	6	29	4	16
Japan	9	50	12	23	8	48	5	73	7	40	11	12	—	3	—	1	—	—	—	—	—	—
Spain	10	46	7	57	7	56	7	45	—	10	17	4	7	6	—	—	—	—	—	—	—	—
Belgium	11	36	—	12	16	10	15	13	—	16	8	20	—	1	8	15	8	8	—	2	—	1
India	12	31	11	23	11	22	16	12	—	15	—	—	—	—	—	—	—	—	—	—	—	—
Italy	13	23	8	47	13	16	9	23	8	29	6	22	6	6	5	65	5	34	4	32	5	6
Argentina	14	20	10	30	10	24	14	14	—	9	13	6	—	—	—	—	—	—	—	—	—	—
Denmark	15	18	—	1	—	4	—	5	—	1	—	—	—	—	—	—	—	—	—	—	—	—
Canada	16	17	—	7	17	8	—	11	—	4	—	2	—	—	—	1	—	—	—	—	—	—
Sweden	17	12	15	14	14	14	10	21	—	9	15	5	—	2	—	—	—	—	—	1	—	1
Switzerland	18	10	14	19	15	14	11	21	—	15	10	14	—	2	11	5	—	3	9	7	—	1
Total (all countries)		1710		1569		1106		961		1412		730		320		1201		771		680		301

TABLE 3

Number of Abstracts by Language

Language	1950		1949		1948		1947		1937		1927		1917		1907		1897		1887		1877	
	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.	Position	No.
English	1	751	1	624	1	491	1	420	1	407	2	214	1	179	2	231	3	147	2	113	3	45
Russian	2	345	2	356	4	102	3	109	2	344	6	17	8	2	6	6	5	18	6	5	—	—
French	3	183	4	175	2	175	2	141	4	126	3	103	3	29	3	231	2	154	3	78	2	53
German	4	182	3	178	3	137	4	80	3	342	1	302	2	75	1	623	1	409	1	440	1	193
Spanish	5	76	5	90	5	83	6	62	6	33	7	16	6	6	—	—	—	—	—	—	—	—
Japanese	6	48	7	20	6	47	5	67	5	34	9	6	7	3	—	1	—	—	—	—	—	—
Czech	7	47	12	9	10	9	—	2	8	17	8	7	—	—	—	—	—	—	5	11	—	—
Italian	8	24	6	47	7	16	7	23	7	29	5	22	5	6	4	65	4	34	4	32	4	6
Dutch	9	20	8	14	8	15	10	8	10	10	4	26	4	17	5	37	6	8	—	—	—	—
Portuguese	10	11	13	9	11	7	8	20	14	6	14	2	10	1	—	—	—	—	—	—	—	—
Jugoslav (Croatian)	11	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Swedish	12	5	9	13	9	13	9	16	12	7	10	5	9	2	—	—	—	—	—	1	—	1
Danish	13	3	—	—	12	3	—	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—
Hungarian	14	3	11	11	13	3	11	6	9	15	—	—	—	—	—	—	—	—	—	—	—	—
Bulgarian	15	2	—	—	—	—	—	—	17	3	—	—	—	—	—	—	—	—	—	—	—	—
Polish	17	0	10	12	14	3	—	—	11	7	13	2	—	—	—	—	—	—	—	—	—	—
Total (all languages)		1710		1569		1106		961		1412		730		320		1201		771		680		301

TABLE 4

PERCENTAGE OF ABSTRACTS BY COUNTRY

Country	1950		1949		1948		1947		1937		1927		1917		1907		1897		1887		1877	
	Position	%	Position	%	Position	%	Position	%	Position	%	Position	%	Position	%	Position	%	Position	%	Position	%	Position	%
United States	1	25.6	1	23.1	1	25.4	1	26.4	3	17.4	2	15.9	1	41.2	3	10.9	4	8.8	5	4.7	6	1.7
Russia	2	20.2	2	22.7	4	9.3	2	11.8	1	25.1	7	3.0	—	0.6	10	0.5	7	2.3	8	1.9	—	0.3
England	3	10.2	3	9.6	3	11.5	3	11.0	4	6.2	4	10.8	3	13.5	4	7.9	3	10.3	2	12.1	3	13.0
France	4	6.5	6	7.6	2	13.1	4	10.6	5	6.2	3	11.4	4	8.8	2	18.0	2	18.9	3	10.4	2	17.3
Germany	5	6.4	4	7.7	5	7.5	6	5.3	2	19.1	1	36.8	2	21.9	1	49.1	1	48.0	1	57.8	1	58.2
Holland	6	5.5	5	7.6	6	5.9	8	2.4	—	1.0	5	3.6	5	5.3	6	3.1	9	1.0	11	0.3	—	—
Czechoslovakia	7	3.5	13	1.3	12	1.6	—	0.3	9	1.7	12	1.0	9	0.9	9	0.5	10	0.4	7	1.9	—	—
Austria	8	3.0	9	2.0	9	3.4	12	2.1	6	5.2	9	2.3	—	—	7	1.9	6	4.0	6	4.3	4	5.3
Japan	9	2.9	12	1.5	8	4.4	5	7.6	7	2.8	11	1.6	10	0.9	—	—	—	—	—	—	—	—
Spain	10	2.6	7	3.6	7	5.1	7	4.7	—	0.7	—	0.6	7	1.9	—	—	—	—	—	—	—	—
Belgium	11	2.1	—	0.8	—	0.9	—	1.3	11	1.1	8	2.7	—	0.3	8	1.3	8	1.0	10	0.3	—	0.3
India	12	1.8	11	1.5	11	2.0	—	1.2	13	1.0	—	—	—	—	—	—	—	—	—	—	—	—
Italy	13	1.4	8	3.0	13	1.5	9	2.4	8	2.1	6	3.0	6	1.9	5	5.4	5	4.4	4	4.7	5	2.0
Argentina	14	1.2	10	1.9	10	2.2	14	1.4	—	0.6	—	0.9	—	—	—	—	—	—	—	—	—	—
Switzerland	18	0.6	—	1.2	—	1.3	11	2.2	14	1.0	10	1.9	—	0.6	11	0.4	11	0.4	9	1.0	—	0.3

TABLE 5

PERCENTAGE OF ABSTRACTS BY LANGUAGE

Language	1950		1949		1948		1947		1937		1927		1917		1907		1897		1887		1877	
	Position	%	Position	%	Position	%	Position	%	Position	%	Position	%	Position	%	Position	%	Position	%	Position	%	Position	%
English	1	44.1	1	39.8	1	44.5	1	43.8	1	28.8	2	29.3	1	56.0	2	19.2	3	19.1	2	16.6	3	14.9
Russian	2	20.2	2	22.7	4	9.3	3	11.3	2	24.4	6	2.3	—	0.6	6	0.5	5	2.3	6	0.7	—	—
French	3	10.7	4	11.2	2	15.9	2	14.7	4	8.9	3	14.1	3	9.1	3	19.2	2	20.0	3	11.5	2	17.6
German	4	10.7	3	11.4	3	12.4	4	8.4	3	24.2	1	41.4	2	23.4	1	51.9	1	53.1	1	64.7	1	64.1
Spanish	5	4.3	5	5.7	5	7.5	6	6.5	6	2.3	7	2.2	6	1.9	—	—	—	—	—	—	—	—
Japanese	6	2.8	7	1.3	6	4.3	5	7.0	5	2.4	9	0.8	7	0.9	8	0.1	—	—	—	—	—	—
Czech	7	2.8	—	0.6	10	0.8	—	0.2	8	1.2	8	1.0	—	—	—	—	—	—	5	1.6	—	—
Italian	8	1.4	6	3.0	7	1.5	7	2.4	7	2.1	5	3.0	5	1.9	4	5.4	4	4.4	4	4.7	4	2.0
Dutch	9	1.2	8	0.9	8	1.4	10	0.8	10	0.8	4	3.6	4	5.3	5	3.1	6	1.0	—	—	—	—
Portuguese	10	0.8	—	0.6	11	0.7	8	2.1	14	0.5	14	0.3	—	0.3	—	—	—	—	—	—	—	—
Jugoslav (Croatian)	11	0.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Swedish	12	0.3	9	0.8	9	1.2	9	1.7	12	0.5	10	0.7	—	0.6	—	—	—	—	7	0.1	5	0.3
Danish	13	0.2	—	—	—	0.3	—	0.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Hungarian	14	0.2	—	0.7	—	0.3	11	0.6	9	1.2	—	—	—	—	—	—	—	—	—	—	—	—

are: the Czech *Chemicke Listy*, the Austrian *Mikrochemie vereinigt mit Mikrochimica Acta*, and the Spanish *Anales de fiscia y quimica*. Some of the more important journals in the late years of the nineteenth century included the German *Repertorium analytische Chemie* (now *Angewandte Chemie*); the American *Journal of the American Chemical Society*, which printed articles dealing with analytical chemistry before the *Analytical Edition* of *Industrial and Engineering Chemistry* was published; the German *Chemiker-Zeitung* and *Pharmazeutische Zentralhalle*, and particularly the German *Zeitschrift fur analytische Chemie*, which was formerly the world leader and is today the leading German periodical serving the field of analytical chemistry.

Examination of the figures in Table 1 indicates that there is about 42 per cent more publication in this field than in 1907 (using *Zentralblatt* figures for 1907), and the number of publication media has about doubled in that time. The year 1917 was very unproductive because of World War I, and there was a corresponding decrease in 1947 because of World War II.

Table 1 shows the 16 leading periodicals (as of 1950) in order. The twelve additional journals listed, beginning with the *Journal of the Chemical Society of Japan*, have enjoyed a measure of importance at some time in the past; an outstanding example is *Chemiker-Zeitung* of Germany, which has had only two articles abstracted in the past five years, but was the world leader in this field in 1907 and 1897, and was second in 1887.

Analysis of Table 2, revealing the relative importance of publication by countries through the years, indicates the rapid growth of publication in the United States—from sixth place in 1877 to first in 1950. The United States took the lead from Germany in 1917, lost it to Germany in 1927, to both Germany and Russia in 1937, then took over the lead in 1947 and has held it since. Russia has now taken a strong second position, following a brief period of leadership in 1937. England, now third, has been a steady third or fourth since 1877. France has always been one of the first five, but has fallen off somewhat from its former position of 1877 to 1907, when it was second to Germany. Germany was the leading publisher until 1917, when it fell to second place; it took the lead again by 1927, but in 1937 began a decline. Holland's new international journal, *Analytica Chimica Acta*, is rapidly assuming importance, and it has made Holland a leading contributor to the literature. Italy was in fifth place in the 1877 to 1907 period but declined to thirteenth place in 1950. Austria also shows a comparable decline in publication figures.

Table 3, showing the number of abstracts by language, indicates that German was the most important language until the first world war, at which time it lost the lead to English. However, German led once more by 1927, only to lose first place again to English by 1937. English has been the most important language ever since. Russian, now second, has become the *leading foreign language*. French has usually been second or third, except in 1937 and 1949, when it was in fourth place. Spanish is now fifth and is followed in order by Japanese, Czech, Italian (fourth in 1877), Dutch, and Portuguese.

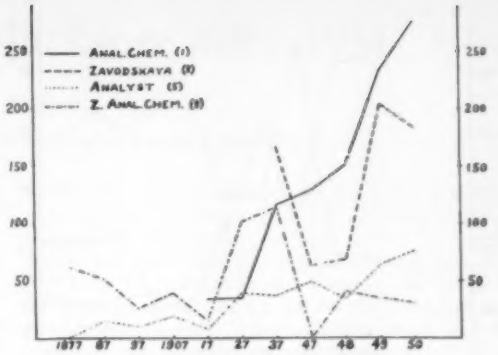

FIG. 1. Abstracts by journal.

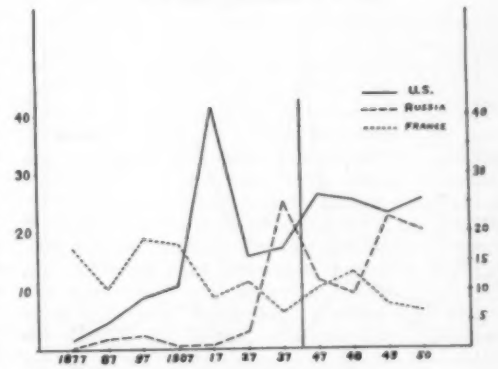

FIG. 2. Percentage by country.

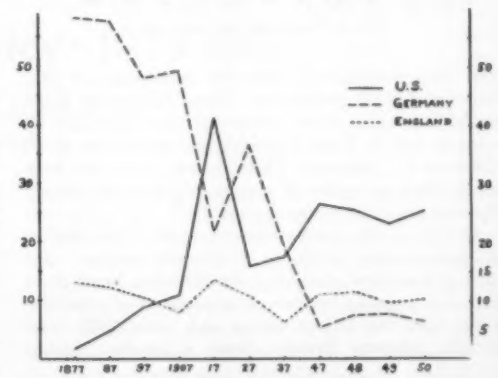

FIG. 3. Percentage by country.

Contributions by country and by language have

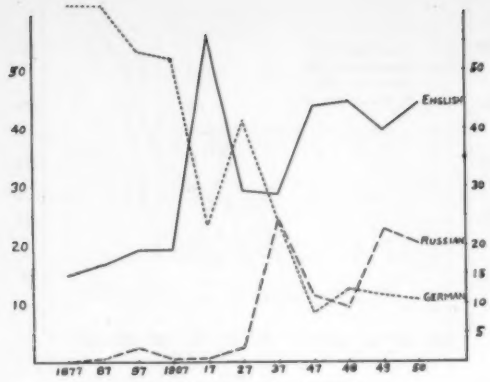

FIG. 4. Percentage by language.

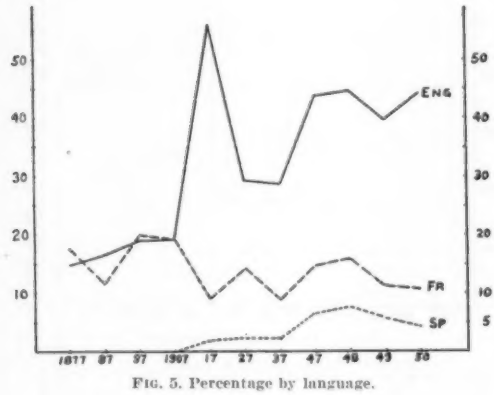

FIG. 5. Percentage by language.

also been investigated from the standpoint of percentage of total publication. These figures are given in Table 4, which shows percentage of all abstracts by country, and in Table 5, which gives percentage of all abstracts by language. These figures have also been interpreted by means of graphs, which reveal clearly the changes in importance since 1877.

In Fig. 3, the most striking feature is the decline of Germany as a publisher of scientific articles in the field of analytical chemistry. On the other hand, there has been a steady increase in importance of contributions from the United States and, since 1927 from Russia, whereas France shows a gradual decline (Fig. 2).

Figs. 4 and 5 show conclusively the decline of German as a language of science and the corresponding increase in the importance of English. It is particularly interesting to note that for each decrease in the one, there is a corresponding increase in the other. In 1950, 44 per cent of all analytical chemistry articles abstracted were in the English language, although in 1917 this figure was 56 per cent, because of the decrease in German publication during the first world war. Russian shows a tremendous increase in importance since 1927—*one article in every five* in this field being published in the Russian language. The French language has suffered a gradual decrease in importance.

CONCLUSIONS

From the data collected, the ten leading journals in the field of analytical chemistry at the present time (from a quantitative standpoint) are, in order: *Analytical Chemistry* (U. S., 1929), *Zavodskaya Laboratoriya* (1935) and the *Zhurnal Analiticheskoi Khimii* (1946) of Russia, *Analytica Chimica Acta* (1947) of Holland, *Analyst* (1876) of England, *Bulletin de la société chimique de France* (1858), *Chemicke Listy* (1907) of Czechoslovakia, *Mikrochemie vereinigt mit Mikrochimica Acta* (1914) of Austria, *Zeitschrift fur analytische Chemie* (1862) of Germany, and *Anales de fisica y quimica* (1902) of Spain.

An analysis of countries contributing to the literature of analytical chemistry shows that the leading five countries in order are now the United States, Russia, England, France, and Germany. In 1877 the order was Germany, France, England, Austria, and Italy. The United States was sixth at this time; in 1897 it was fourth; in 1917, first, but third in 1937; and by 1947 it had reached first place and has remained there. The languages of publication in order of importance are now English, Russian, French, German, and Spanish. In 1877 the order was German, French, English, and Italian.

Graphical representation, with percentage of total abstracts by country and by language plotted against years, reveals that about 1947 the United States took over the lead from Germany in total publication, and by 1937 the English language had replaced German as the leading language in this field.

Investigation of total publication in all fields of chemistry[3] reveals that world publication fell off from 1913 to 1918 during the first world war, increased until the peak year of 1938, and then rapidly declined during the period of the second world war from 1938 to 1945. Since 1945 there has been a steady increase in volume.

[3] E. J. Crane. *Chem. Eng. News*, **27**, 529 (1949).

Herbert Spencer Jackson: 1883–1951

D. L. Bailey

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AMERICAN BOTANISTS lost a recognized leader and the field of systematic mycology one of its great men of all time in the sudden death of H. S. Jackson on December 14, at his home in Toronto.

Herbert Spencer Jackson was born in New York state in 1883 and received his college education from Cornell, Harvard, and Wisconsin universities. He held posts at the universities of Delaware and Oregon and was chief in botany at the Purdue Agricultural Experiment Station for thirteen years before coming to Toronto University in 1929 as professor of mycology in the Department of Botany, of which he was the head from 1941 on. He had long been deeply interested in problems associated with the origin, development, and classification of fungi. Before coming to Toronto he was recognized as a world authority on the rust and smut fungi, and to our knowledge of these groups he contributed thirty-one journal articles.

In the Toronto area Professor Jackson found conspicuously few rust species, the study of which could be counted on to elucidate further the problems in rust phylogeny and relationships in which he was interested. Consequently, he gradually shifted his emphasis to the Thelephoraceae, a neglected group of great basic significance, and important as well in the carbon cycle as wood-destroying fungi. To a better understanding of this group, he and his students have contributed some sixteen articles, and it is hoped that several more are sufficiently advanced to be completed by his colleagues. Dr. Jackson was largely instrumental in building up the fungus herbarium in his department, until it now numbers some 94,000 accessions and includes an unusually complete collection of the fungi occurring in a unique region, the Temagami Forest Reserve.

Although he was a modest and retiring gentleman, Professor Jackson was a man of ready understanding and of broad sympathy, with whom friendship developed slowly but was an exceedingly rewarding experience. He will be universally mourned as a scholar and a stalwart of his science, and deeply and lastingly so by all who called him friend. Iris and his stamp collection were his hobbies, and in connection with the former, during his last year, he built himself a fitting memorial by bringing together at the Glendon Hall Botanic Garden in Toronto a collection of nearly 500 of the newer iris varieties of distinction, to found the finest collection of its sort in Canada. He is survived by his wife, Edythe Doyle Jackson; by a daughter, Mrs. C. D. Barrett, of Imlay City, Michigan; and by a son, K. K. Jackson, of Ithaca, New York.

Harry Federley: 1879-1951

Richard B. Goldschmidt

Department of Zoology, University of California, Berkeley

IN HARRY FEDERLEY, Finland has lost her greatest geneticist and cytologist. The science of genetics mourns one of the founders of modern cytogeneties, which was started on its new path (after Boveri) by Federley, together with Rosenberg, Gates, and Sakamura between 1910 and 1920.

Federley's external life was not very eventful. He studied at the University of Helsinki, where he received his Ph.D. in 1907, became an instructor in zoology in 1909, an instructor in genetics in 1915, and professor of genetics and head of the newly founded Genetics Institute in 1923. In between he worked for periods of up to two years in Berlin, Jena, and Stockholm, and he was a permanent secretary of the Finnish Science Society. He received honorary degrees from the universities of Lund and Copenhagen.

Federley's scientific work started in mycology, but he soon turned to the Lepidoptera as material for his investigations. He was an excellent ecologist and taxonomist of this group, and besides his genetical and cytological work, he published numerous papers on all phases of the biology of the Lepidoptera, including also very interesting temperature experiments and studies on geographic variation. Most of his papers, however, dealt with the chromosomes of Lepidoptera and with hybridization in this group. All these papers were models of good observation, clean technique, and theoretical understanding. They firmly established his place in the history of the genetics and cytology of the past 40 years. But his magnum opus was the work from 1911 to 1913 on species hybrids in moths and their cytology. Here he discovered in certain crosses numerous variations in synapsis between homologous chromosomes, ranging from complete synapsis to complete asynapsis. This

discovery enabled him to produce triploids and to conclude that true-breeding allotetraploids (a later term) could be originated from species crosses. His work enabled Standfuss soon afterwards to find the correct explanation for the triploid intersexes that he had produced in moths. Furthermore, this brilliant piece of work, together with Rosenberg's work on *Drosera* and Winge's theoretical analysis, has been the basis of all cytogenic work on species hybrids.

Federley, who was the first to start genetical and cytological work in his country, naturally exerted an immense influence upon Finnish biology and university life. His school has been very successful, and he was beloved and revered by his students and colleagues. In his later years he devoted much time to human heredity, especially to an effort to make the general population conscious of its importance. During the difficult war period, when his institute was bombed, he remained a pillar of freedom. In his private life he was a quiet, charming, family man, who loved fun and the good things of life. Those who knew him intimately have lost in him a fine, noble, upright, and courageous friend, in addition to a brilliant investigator.

News and Notes

Research Laboratory, The Carver Foundation

THE new $250,000 research laboratory building of the George Washington Carver Foundation, science research organization of Tuskegee Institute, was dedicated on February 12. The dedicatory address, entitled "Fantasy in Prophecy," was delivered by Henry Gilman, professor of chemistry, Iowa State College. Dr. Gilman was introduced by Roy C. Newton, vice president of Swift & Company, and trustee of the Carver Foundation, who sketched the progress in research made by the Carver Foundation during the past few years. Dr. Gilman also gave a talk to a seminar group on the subject "Organometallic Chemistry," as an added feature of the dedication.

The building, constructed of steel and concrete block with brick veneer, is U-shaped and has a frontage of 129 feet and a depth of 96 feet. It has 21 laboratory modules, 10′ × 22′, with relocatable partitions, offices for the administrative and senior staff personnel, and general utility rooms that include a library-seminar room, incubator room, refrigerated and ice storage rooms, darkroom containing a section with controlled temperature and humidity, special apparatus room, and stock and storage rooms. The concrete block used is a type developed and made by Tuskegee Institute; the architect, engineer, and superintendent of construction were members of the Tuskegee Institute staff, and the skilled labor was furnished by students in the School of Mechanical Industries during their industrial apprentice practice periods.

The Carver Foundation is Tuskegee Institute's organized unit for the administration of research sponsored by outside agencies. The research staff consists mainly of members of the faculty in the various science departments in the several schools of the institute, and research fellowships are awarded to graduate students. During the current year research in the pure and applied sciences is being sponsored through grants and contracts with the following agencies: Continental Can Company, Damon Runyon Memorial Fund for Cancer Research, Inc., International Minerals and Chemical Corporation, National Distillers Products Corporation, National Institutes of Health, Nutrition Foundation, Bureau of Human Nutrition and Home Economics (USDA), Office of Naval Research, The Parker Pen Company, Research Corporation, Swift & Company, and the Upjohn Company. Since this activity was initiated in 1945, approximately $150,000 for research has been received from off-campus agencies, and fellowships totaling approximately $50,000 have been awarded to 39 graduate students.

The Carver Foundation was established by the late George Washington Carver, and his life's savings represent the original endowment. The funds for the building were received as donations from foundations, industries, and individuals.

R. W. BROWN
The George Washington Carver Foundation
Tuskegee Institute, Alabama

Scientists in the News

Samuel J. Ajl, assistant professor of bacteriology at Washington University Medical School, has been appointed chief of the Microbiological Chemistry Section in the Department of Bacteriology, Army Medical Service Graduate School.

Paul R. Burkholder, chairman of the Department of Plant Science at Yale, has been designated a Sigma Xi national lecturer to discuss "Cooperation and Conflict among Primitive Organisms" before seven clubs and chapters of the Society of the Sigma Xi and Resa in Rhode Island, New York, New Jersey, Pennsylvania, and Ohio.

David Marion Delo has been appointed president of Wagner College on Staten Island and will assume his new post in July. He succeeds **Walter C. Langsam,** who leaves July 1 to become president of Gettysburg

College. Dr. Delo has been executive secretary of the American Geological Institute since 1949.

Morse G. Dial has been elected president of the Union Carbide and Carbon Corporation. Mr. Dial, who joined the company in 1929, became assistant secretary and assistant treasurer in 1939, secretary and treasurer in 1945, vice president and director in 1949, and a member of the executive committee and executive vice president last year.

Harold W. Elley, technical director of the Du Pont Organic Chemicals Department, has been elected chairman of the board of directors of the National Association for Mental Health. Prior to 1950, when the National Committee for Mental Hygiene, the National Mental Health Foundation, and the Psychiatric Foundation were merged to form the National Association for Mental Health, Dr. Elley was president of the Psychiatric Foundation. The association is a citizens' group working to promote good mental health and prevent mental and emotional illness.

Samuel P. Ellison, Jr., professor of geology and consultant to the Bureau of Economic Geology and University Lands, was appointed chairman of the Department of Geology, University of Texas, effective February 1952. He replaced **A. H. Deen,** who has resigned.

Stewart S. Howe has been named vice president in charge of development and public relations at Illinois Institute of Technology and Armour Research Foundation. He resigned from a similar position in the National Sanitation Foundation, Ann Arbor, Mich., to assume his new duties.

Clyde E. Keeler, professor of biology at the Georgia State College for Women, Milledgeville, has won the Research Competition Award of the Association of Southeastern Biologists for his paper entitled "The Caribe-Cuna Moon-Child and its Heredity." Dr. Keeler holds the distinction of being the only person to have achieved this honor twice, having won a similar award from the same organization in 1947.

Morris S. Kharasch has been chosen to receive the 1952 Theodore William Richards Medal of the American Chemical Society's Northeastern Section. The medalist, who is Carl William Eisendrath professor of chemistry at the University of Chicago, was cited for his contributions to the theory and practice of organic chemistry, particularly for his work on the organomercury compounds. The Richards Medal was established in 1930 in honor of the late Professor Richards of Harvard University, first American chemist to win a Nobel prize.

C. Donald Larsen has been appointed executive secretary of the Cancer Control Committee of the National Cancer Institute. The committee, which functions as a preliminary review board for the National Advisory Cancer Council, consists of 13 nongovernmental cancer authorities, who serve as advisers for the cancer control program. In his new position, Dr. Larsen will review applications for special cancer control projects submitted by universities, teaching centers, and state, municipal, and private nonprofit organizations requesting financial support from the National Cancer Institute.

John S. Leach, executive vice president of the Texas Company, has been elected president to succeed **Harry T. Klein,** who was elected to the newly created office of chairman of the executive committee. Colonel Klein joined the Texas Company in 1921 as assistant general counsel. He had been president since 1944.

Hubert S. Loring, professor of biochemistry at Stanford University, has been appointed visiting Walker-Ames professor of biochemistry at the University of Washington, where, during the current quarter, he is offering a lecture course on the biochemistry of nucleoproteins, nucleic acids, and their components.

Stanley J. Mack has been appointed head of the laboratory of Arthus S. La Pine & Company, Chicago. Mr. Mack formerly worked with the Anderson Pritchard Company as a processing engineer and as a staff engineer for George S. May Co.

Rollins College has named **Hugh F. McKean** president. He had been acting president since last May, when he succeeded **Paul A. Wagner.** A Rollins graduate and member of the art faculty for twenty years, Mr. McKean was elected president of the Florida Federation of Art last year.

Raymond F. Male, of Princeton, N. J., has been appointed administrative director of the National Association for Mental Health. Mr. Male is director of personnel for the city of Philadelphia.

William Montagna and **Herman B. Chase,** associate professors in the Department of Biology, have been promoted to the rank of full professors at Brown University. Both have been members of the biology department for four years and recently have concentrated on the study of skin growth.

Gardner Murphy, chairman of the Psychology Department, City College of New York, has been appointed research director of the Menninger Foundation, nonprofit psychiatric center in Topeka, Kan., which has undertaken a $1,365,000, three-year research and educational program. Dr. Murphy, former president of the American Psychological Association, will replace **Sibylle K. Escalona,** who will join the research staff of the Institute of Human Relations, Yale University. **J. Cotter Hirchberg,** professor of psychiatry at the University of Colorado Medical Center, was appointed director of the foundation's Department of Child Psychiatry.

James Newby, general secretary of the International Association for the Exchange of Students for Technical Experience, arrived in New York on Apr.

29 for a few months' visit at the invitation of the U. S. State Department. His immediate concern is to discuss with industrialists the value of accepting students from Britain and Europe as vacation workers in American factories in return for the reception of U. S. students in Europe. The International Association for the Exchange of Students for Technical Experience was founded in 1948 on the initiative of the Imperial College of Science and Technology, South Kensington, London, and it acts there for 24 British universities and colleges taking part in the exchange plan. Last year a total of 2433 students was enabled through the association to go overseas to gain experience in industry and commerce. Students of mechanical engineering are in the majority, but many other subjects, such as agriculture, geodesy, and textile engineering are among the 22 topics that have been studied by those seeking practical experience in another country. While in this country, Mr. Newby may be reached through Douglas N. Batson, Educational Exchange Services, Department of State, Washington 25, D. C.

Charles S. Pichamuthu, director of the Geology Department of the government of Mysore, Bangalore, India, has arrived in the U. S. for a four-month study of geological research institutions.

Oliver Pilat, author of *The Atom Spies,* shared the Page One award of the New York Newspaper Guild with **William V. Shannon** for his work on the New York *Post.*

Henry Alsop Riley, who has been associated with the Neurological Institute for more than 30 years, will retire as chief of the West Service of the institute in June, but will continue as consulting neurologist. Attending neurologist and chief of the West Service since 1938, Dr. Riley has been associated with Columbia University since his graduation from the medical school there in 1912. He has also been in the private practice of neurology since 1916.

Joseph R. Shaeffer, chief of surgery at Brooke Army Hospital, Fort Sam Houston, has been named to succeed **Warner F. Bowers** as chief surgical consultant to George E. Armstrong, the Army Surgeon General. Colonel Bowers will assume the position Colonel Shaeffer vacates at Brooke. Both officers will take on their new duties July 1. During Colonel Shaeffer's three-year term at Brooke, he was instructor in military surgery at the Medical Field Service School and professor of surgery at the Graduate School of Baylor University.

Ralph G. H. Siu has been designated associate technical director of the Research and Development Division, Office of the Quartermaster General. It is the intent of the Research and Development Division that Dr. Siu will continue to serve as consultant on basic research and as chief of the Pioneering Research Laboratories. Dr. Siu has been associated with the Philadelphia Quartermaster Depot since 1946, having at that time accepted an appointment as director of research and development. Prior to this appointment he was a consultant with the Research and Development Division of the Office of Quartermaster General in Washington.

Newbern Smith, chief of the National Bureau of Standards Central Radio Propagation Laboratory, has received the 1952 Harry Diamond Memorial Award for his fundamental work in the field of radio wave propagation. Dr. Smith's work has formed the basis for the practical use of ionospheric observations in the operation of world-wide communication systems. Dr. Smith joined the NBS staff in 1935 as a physicist in the Radio Section of the Electricity Division.

Erol Tumeretkin, of Istanbul, has been named Whitbeck Fellow for the 1952–53 college year and will pursue graduate studies at the University of Wisconsin Department of Geography. The Whitbeck Fellowships were established in 1937 by the late Ray H. Whitbeck, for 30 years a member of the department. Over $60,000 was set aside in his will for yearly fellowships and for grants to members of the geography staff for foreign travel or writing.

J. C. T. Willis, Division of Military Surveys for the British government, visited the Topographic Division of the Geological Survey in the course of an inspection tour of military agencies in the U. S.

Lyman J. Wood, professor of chemistry at St. Louis University, is scheduled to give a report on "Migration of Ions through Crystals" before the International Symposium on the Reactivity of Solids at Gothenburg, June 9–13. The meeting is sponsored by the Royal Swedish Academy of Engineering and the Chalmers University of Technology. He also plans to visit various universities in England, Germany, and France.

Education

At the **Friday Harbor Laboratories** of the University of Washington, George F. Papenfuss, associate professor of botany at the University of California, will conduct a course in marine algology June 21–Aug. 22. Dr. Papenfuss will emphasize the taxonomy and morphology of marine forms, as well as techniques of shore collecting and dredging. Information regarding this and other courses to be given at the laboratories this summer may be obtained from Richard H. Fleming, Department of Oceanography, University of Washington, Seattle 5.

Hunter College has appointed John J. Meng to the newly created position of dean of administration. He will take office on Sept. 1. Dr. Meng will serve as executive officer of the Bronx campus and work to correlate the activities of the Bronx and Park Avenue campuses to insure unity of purpose and policy.

The New **Huston-Tillotson College** in Austin, Tex., formed by the merger of two church colleges for Negroes, has elected Matthew S. Davage president.

Dr. Davage has been head since 1940 of the Methodist Board of Education's Department of Higher Education for Negroes.

The **Institute of General Semantics** will hold its ninth summer seminar-workshop at Bard College Aug. 17–Sept. 1. Courses will be presented by the institute staff and associated co-workers from other institutions. For full information, write to the institute registrar, Lakeville, Conn.

Stanford University School of Medicine will offer post graduate courses for a limited number of practicing physicians Sept. 15–19. For information apply to the dean, 2398 Sacramento St., San Francisco 15.

Grants and Fellowships

The **American Society of Biological Chemists** and the Division of Biological Chemistry of the **American Chemical Society** will make available a limited number of travel awards of $700 each to aid American biochemists to attend the International Congress of Biochemistry to be held in Paris July 21–27. Awards will be restricted to persons under 40 years of age, but not to members of the two organizations. Applicants who have not previously been to Europe and who would be unable to attend the congress without an award will be favored. For application forms write *immediately* to Elmer H. Stotz, Department of Biochemistry, University of Rochester School of Medicine and Dentistry, Rochester 20, N. Y.

The **Atomic Energy Commission** has inaugurated a one-year fellowship training program for industrial hygienists, at the University of Rochester, starting in the fall of 1952. Up to four will be selected by a committee headed by H. F. Schulte. Stipends will be $1500 per annum if single, an additional $500 if married, and $250 additional for each of two dependent children. If the fellow has completed one or more years of graduate work in a related field, he will be allowed $200 more. Applicants must have a degree in engineering (preferably chemical), chemistry, or physics. Blanks may be obtained from Merril Eisenbud, New York Operations Office, AEC, P. O. Box 30, Ansonia Station, New York 23.

The **Sol Dreyfuss Memorial Fellowship** in psychology has been made possible at Southern Methodist University by an annual gift of $1500 from Mr. and Mrs. Lawrence Pollock, of Dallas. To be awarded for the first time in 1952, the fellowship is designed to cover study and research in the field of human relations in industry and is intended for a student working for the M.A. degree in the Department of Psychology. A. Q. Sartain, chairman of the department, will furnish additional information.

Kappa Delta Phi, professional education fraternity, and the **National Society for Crippled Children and Adults** have established a $1000 scholarship in the University of Chicago School of Social Service Administration for a qualified graduate student in medical social work. Applications are available from the National Personnel Registry of the society, 11 S. La Salle St., Chicago 3.

Monsanto Chemical Company has established a $1200 graduate fellowship in the School of Textiles at North Carolina State College. It will be open to qualified students in chemistry, chemical or mechanical engineering, or physics.

The **National Institute of Arthritis and Metabolic Diseases** will aid the manufacture of radioactive cortisone for use in medical research by means of a fund of $66,000, to be administered by a small committee of scientists from nonfederal research institutions. Charles Huggins, of the University of Chicago, will head the group that will plan the project, bring together the starting materials, and contract with a suitable manufacturer. The product will be distributed to qualified scientists who submit formal research proposals to the institute.

In the Laboratories

The Clinical Research Division of the **Chemical Corps Medical Laboratories**, Army Chemical Center, Md., has recently been reorganized, with Amedeo S. Marrazzi as chief. The Clinical Investigation, Pathology, and Neurology branches are included in the new division. E. Ross Hart is chief of the Neurology Branch, which is also new.

Eaton Laboratories, Norwich, N. Y., have appointed three new research workers to their staff: Michael P. Natt (parasitology), Melvin J. Bryson (biological chemistry), and Americo Woyciesjes (mycology). The medical department has been expanded by the appointment of Paul F. McLeod, George S. Rogers, and Harold D. B. Roberts. Dr. Roberts will head a new veterinary division. At a conference on the action of nitrofurans on endocrine glands held recently at the laboratories, the following were among the speakers: Warren O. Nelson, Marguerite Sykes, Donald A. Clarke, T. C. Pomeroy, and Charles Friedgood.

Franklin E. Satterthwaite, of General Electric Company, has joined the Operations Research Group of **Arthur D. Little, Inc.** Other recent additions to the staff include Harold Morian, Alton Poole, and Francis Graves.

Los Alamos Scientific Laboratory has added the following scientists to its staff: Burel E. McGarrahan (GMX Division); Darrel W. Morgeson (Weapons Division); and W. Robert Spensley (Documentary Division).

I. W. McLean, Jr., former virus research coordinator, has been named assistant director of **Parke, Davis** microbiological research, and the following have been appointed laboratory directors in their respective fields: Daniel A. McGinty (physiology), Jean K. Weston (pathology), Graham M. Chen (pharmacodynamics), and John Ehrlich (antibiotics).

Meetings and Elections

Alpha Chi Sigma, national professional chemical fraternity, will hold its 50th anniversary meetings at the University of Wisconsin June 22–26. The fraternity was founded on the Wisconsin campus by J. H. Mathews, retiring chairman of the Wisconsin Department of Chemistry, and seven other students. E. M. Larsen, of Wisconsin, is general chairman of the meetings; persons desiring to attend should get in touch with him or with Paul Bender, 51 Chemistry Bldg., Madison 6, Wis.

The **American Institute of Planners** has elected Frederick P. Clarke, planning director of the Regional Plan Association, president. Other officers named at the annual meeting were John T. Howard, vice president, and Harry E. Burgh, secretary-treasurer.

The **American Oil Chemists' Society** elected E. M. James, technical adviser to the board of Lever Brothers Company, president for 1952–53; Procter Thompson was elected vice president, and T. H. Hopper and J. J. Vollertsen were re-elected secretary and treasurer, respectively. A. R. Baldwin, W. A. Peterson, and N. A. Ruston were elected members-at-large.

The **Histochemical Society** elected the following officers at its meeting in New York in April: president, Stuart Mudd; vice president, J. Walter Wilson; secretary, Ralph D. Lillie; treasurer, Edward W. Dempsey. Arnold Lazarow and Albert H. Coons were elected councillors for four-year terms.

An **International Conference on Beta and Gamma Ray Activity,** to be held in Amsterdam Sept. 1–6, is being organized by the Netherlands Physical Society and the International Union of Pure and Applied Physics. G. J. Sizoo, C. J. Bakker, J. de Boer, W. J. Beekman, H. Brinkman, H. B. G. Casimir, A. D. Fokker, S. R. de Groot, H. A. Kramers, R. Kronig, and J. M. W. Milatz make up the organizing committee. Applications for participation must be made as soon as possible, and contributors are urgently requested to send title and summary of their communications to J. de Boer, Bunsenstraat 98, Amsterdam O.

The **National Academy of Sciences,** at its annual meeting in Washington, D. C., Apr. 28–30, re-elected William J. Robbins treasurer, and Robert F. Loeb and Wendell M. Stanley members of the Council, to serve until June 30, 1955. Thirty new members were elected, and Neils Bjerrum, Tadeus Reichstein, and Harald U. Sverdrup were elected foreign associates.

At its annual meeting in Decatur, Ga., the **Association of Southeastern Biologists** elected the following officers: president, Margaret Hess; vice president, C. S. Shoup; secretary-treasurer, Mary Esther Gaulden. Bruce D. Reynolds is the new president-elect. Clyde E. Keeler received the Carolina Biological Supply Company award, Robert D. Ross the Phipps and Bird Fellowship for summer research at the Mountain Lake Biological Station, and Mary S. McDougall the new award of the Southern Scientific Company, Atlanta, for "meritorious service and contributions as a teacher and leader in biology."

Miscellaneous

The **American Physiological Society** has undertaken a study with the purpose of exploring physiology as a science and of furthering its contribution to the welfare of the U. S. A guiding committee has been formed to direct the study in its broad definition of the physiological aspects of biological science and pertinent applications, under the chairmanship of R. W. Gerard, with W. O. Fenn as deputy chairman. A subcommittee, working under Gerard and Fenn, will study the character and trends of physiological science; personnel aspects of the science will be investigated by a subcommittee under the guidance of R. S. Morison and H. B. Steinbach; communication (and teaching) from public, organizational, and international standpoints will be examined by M. S. Visscher and A. C. Burton; research aspects, or the operating conditions under which research is conducted, and possible improvements, will be considered by David R. Goddard and Dr. Fenn; and, finally, the application of suggested solutions to those problems faced in medical, industrial, governmental, and agricultural channels of physiological science will be guided by Morris Tainter and another yet to be selected. Orr E. Reynolds has been appointed executive secretary for the initial phase of the study and will be on leave from his position as director of the Biological Sciences Division of the Office of Naval Research, for the duration of his service in such capacity. Dr. Reynolds' offices are in the Dupont Circle Bldg., Washington, D. C., a part of the headquarters of the society. John P. Lindsay will serve as acting director of the Biological Sciences Division in Dr. Reynolds' absence from ONR. The "physiology assay" will be made in two phases. The first, planned for nine months or less, will formulate the full set of problems, collect and evaluate available data, and create basic instruments and procedures for further research. The second phase, planned for 18 months, will carry out the actual research studies. Financial support of the study is being provided by the National Science Foundation.

Effective June 1, the central office of the **National Association of Corrosion Engineers** will be moved to larger quarters at 1061 M & M Bldg., 1 Main St., Houston 2, Texas.

The following have been elected trustees of **Science Service:** Duane Roller, nominated by the National Research Council; Charles E. Scripps, chairman of the Edward W. Scripps Trust; and Homer W. Smith, nominated by the National Academy of Sciences. Harlow Shapley was re-elected president, and Alexander Wetmore vice president. O. W. Riegel, treasurer, and Watson Davis, secretary, were also re-elected.

Technical Papers

Degradation of Radioactive Glucose[1]

P. V. Vittorio, G. Krotkov, and G. B. Reed

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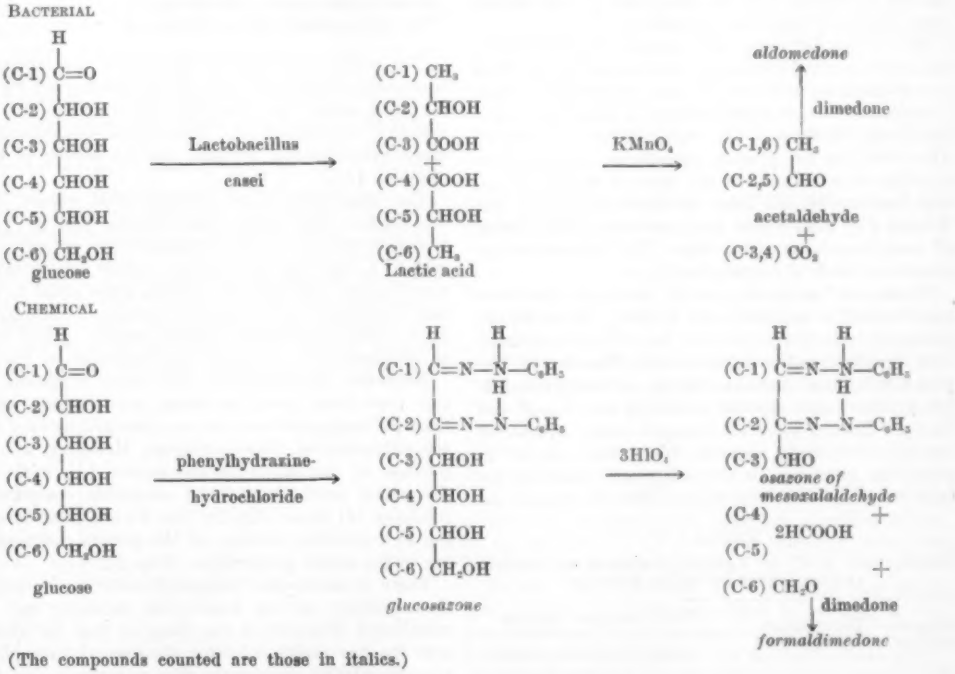
In the original method of glucose degradation used by Wood, Lifson, and Lorber (*1*), glucose is at first converted by *Lactobacillus casei* to lactic acid. By subsequent chemical degradation CO_2 derived from different positions of this lactate is precipitated and counted as $BaCO_3$. This method has been tested by other workers and found to be dependable. Since CO_2 derived from various positions of a glucose molecule is always counted as $BaCO_3$, a comparison of relative activity throughout a glucose molecule becomes an easy matter. Unfortunately this method is laborious and time-consuming. Moreover, the plating and counting of $BaCO_3$ present a number of difficulties.



(The compounds counted are those in italics.)

FIG. 1. The scheme for glucose degradation.

In an attempt to eliminate these drawbacks Aronoff and Vernon (*2*) suggested a method based on an entirely different principle. Glucose is at first converted to glucosazone and this is degraded with periodate. The products are bisphenylhydrazone of mesoxalaldehyde derived from C-1 + C-2 + C-3 of glucose, formic acid from C-4 and C-5, and formaldehyde from C-6. Formaldehyde is precipitated with dimedon and counted as such. Bisphenylhydrazone of mesoxalaldehyde is further oxidized by 1% KOH in absolute ethanol, yielding a precipitate of glyoxalosazone derived from C-1 + C-2.

Activity in C-1 + C-2 + C-3 is determined from counting bisphenylhydrazone mesoxalaldehyde. C-1 is presumed to be equal to C-6. C-1 + C-2 is determined from glyoxalosazone, and C-2 is equal to C-1 + C-2 − C-1. It is claimed by these authors that their method is rapid and that all the compounds formed are easily separated and readily plated with pyridine.

Since the present authors were faced with the problem of degrading a very large number of glucose samples, it was decided to try Aronoff and Vernon's method. We have, however, experienced a difficulty in the step involving the degradation of bisphenylhydrazone of mesoxalaldehyde with 1% alcoholic KOH. The reported (*3*) melting point of glyoxalosazone is 178°–180° C, but the crystals obtained

[1] This work has been carried out with financial assistance from the National Research Council of Canada.

TABLE 1

Product counted	Av atomic number
Glucosazone	3.96
Bisphenylhydrazone mesoxalaldehyde	4.1
Aldomedone	3.5
Formaldimedone	3.5
($BaCO_3$	17)

by us in this step only occasionally had this value. In the majority of cases their melting point was 123°–125° C. We could not, therefore, duplicate this step.

It is clear, therefore, that the step in Aronoff and Vernon's technique of obtaining the C-1 + C-2 value by degrading bisphenylhydrazone of mesoxalaldehyde with alcoholic potash is not dependable. Until more is known about the products of this reaction, the technique of Aronoff and Vernon, as proposed by these authors, cannot be used.

The other steps of their method, however, have been found satisfactory, and because of the advantages of this method we did not wish to drop it. The method, as claimed by the authors, is rapid, and the various products, with the exception of glyoxalosazone, are easily obtained and plated.

In a search for some other method of precipitating and counting C-1 + C-2, we decided to isolate these two carbons as acetaldehyde and precipitate it with dimedone (*4*). Such a precipitation is quantitative and rapid, and the crystals are readily plated in pyridine. The technique for glucose degradation becomes now a combination of some of the steps of Wood, Lifson, and Lorber (*1*) and some of those of Aronoff and Vernon (*2*), plus a new step involving precipitation of acetaldehyde as aldomedone. Fig. 1 presents the scheme of such a degradation.

Glucose is fermented with *L. casei*, and the lactic acid formed is oxidized with $KMnO_4$. Acetaldehyde produced from C-1 + C-2 or C-6 + C-5 is precipitated with dimedone and counted as such. Glucosazone, bisphenylhydrazone mesoxalaldehyde, and formaldehyde are produced and counted according to Aronoff and Vernon. Table 1 gives the average atomic number of various compounds counted. Since this number is about the same for all the compounds counted, the backscattering effects are similar. For this reason the activities of such compounds are directly comparable.

Two samples of glucose, with uniform and non-uniform distribution of C^{14} in various positions, were degraded using both our proposed modification and the original scheme of Wood, Lifson, and Lorber. The results are given in Table 2, which shows that the results obtained by both methods agree within about 2.5%.

TABLE 2

DISTRIBUTION OF C^{14} IN VARIOUS POSITIONS OF GLUCOSE AS PERCENTAGE OF TOTAL ACTIVITY

Glucose sample	Degradation technique used	Carbon atoms of glucose		
		3 and 4	2 and 5	1 and 6
1	Wood, Lifson, and Lorber	34.5	32.5	33
1	Vittorio, Krotkov, and Reed	33.7	32.1	34.2
2	Wood, Lifson, and Lorber	52	25.9	22.1
2	Vittorio, Krotkov, and Reed	50.9	26.1	23.0

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Competition of the Aliesterase in Rat Serum with the Pseudo Cholinesterase for Diisopropyl Fluorophosphonate[1]

D. K. Myers

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The molar concentration of pseudo cholinesterase in certain mammalian sera can be determined by the use of a competitive reversible inhibitor, Nu-683, the dimethyl carbamate of (2-hydroxy-5-phenylbenzyl) trimethylammonium bromide, and an analog of prostigmine (*1*).

The concentration of inhibitor that causes 50% inhibition of the pseudo-cholinesterase activity (I_{50}) is determined at various concentrations of serum; a plot of I_{50} against the relative enzyme concentration should give a straight line with a slope equal to one half the molar concentration of pseudo cholinesterase in the serum solutions. Typical results of this kind as obtained with rat serum are indicated in Fig. 1.

Extensive investigations with other inhibitors of this type have failed to reveal any enzymes other than the cholinesterases that are inhibited by very low concentrations of these inhibitors. Moreover, a comparison of the experimental results (*1*) with the theoretical predictions for a reversible competitive inhibitor (*2*) shows directly that Nu-683 must be acting as a selective inhibitor of the pseudo cholinesterase in the serum preparation (Fig. 2).

There is no similar theoretical criterion by which the selectivity of an irreversible inhibitor can be established. However, it was observed that the results with the irreversible inhibitor diisopropyl fluorophosphonate (DFP) frequently give a higher value for the apparent cholinesterase concentration than that obtained by the above technique with Nu-683. Thus it appears that the results obtained with DFP must be at fault for some reason.

One source of error was revealed by experiments

[1] This work was carried out under the guidance of B. Mendel and with the technical assistance of M. de Jonge.

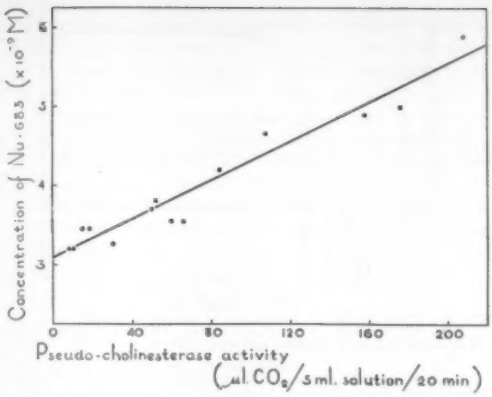

FIG. 1. Determination of the molar concentration of pseudo cholinesterase in rat serum by the use of Nu-683. The experimental points should fall on a straight line of the equation $I_{50} = K_i + 0.5\ E$ (*1, 2*). From the graph, the Michaelis constant $K_i = 3.1 \times 10^{-9} M$ Nu-683, the enzyme concentration $E = 2.45 \times 10^{-9} M$ pseudo cholinesterase in a solution which gives an activity of 100 μl CO_2/5 ml/20 min toward benzoylcholine.

on the inhibition of the pseudo cholinesterase of rat serum by DFP. As in the previous investigation (*1*), the relative enzyme concentration was expressed on the basis of esterase activity, the standard unit of activity being 1 μl CO_2/ml solution/min, with a pH of 7.4, a temperature of 37.5° C, and a 0.025 *M* bicarbonate medium. The pseudo-cholinesterase concentration in rat serum, as determined by the use of Nu-683, was 2.5×10^{-9} *M* in a solution which gives 1 unit of activity toward benzoylcholine. The results with DFP indicated a value that was 250 times larger (Table 1).

It is known that DFP is a moderately potent inhibitor of hydrolytic enzymes other than the cholinesterases (*3–5*), and it had been reported previously that the aliesterases of rat serum show an abnormally high sensitivity to DFP (*6*). Thus it was possible that the presence of the aliesterases in normal rat

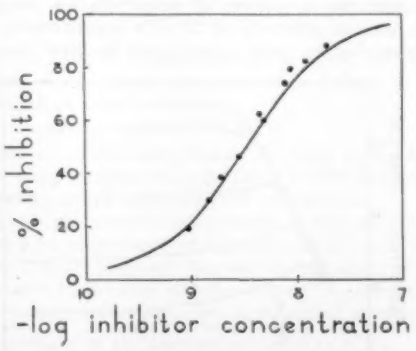

FIG. 2. Relation between the percentage inhibition of pseudo-cholinesterase activity and the logarithm of the concentration of Nu-683. The theoretical line is calculated from the theoretical equations of Goldstein (*2*) for a reversible competitive inhibitor which combines with the enzyme-active center on an equimolar basis. $K_i = 3.1 \times 10^{-9} M$, $E = 1.2 \times 10^{-9} M$.

serum interfered with the reaction between DFP and the pseudo cholinesterase.

In the previous investigation (*6*), ethyl chloroacetate had been used as substrate for the aliesterases, since it is hydrolyzed much more rapidly than the usual substrate, tributyrin. The results with tributyrin, however, can be more easily reproduced than those with ethyl chloroacetate, and the same aliesterase seems to be responsible for the hydrolysis of both esters by rat serum. Thus a 0.2% tributyrin emulsion was used as substrate for the aliesterases in the present investigation.

TABLE 1

Inhibitor	Treatment of serum	Intercept on I_{50} axis	Apparent enzyme concentration in a solution which gives 1 μl CO_2/ml/min toward benzoyl choline
Nu-683	Normal	$3.1 \times 10^{-9} M$	$2.45 \times 10^{-9} M$ pseudo cholinesterase
DFP	"	0	$6.5 \times 10^{-7} M$ pseudo cholinesterase
		0	$4.6 \times 10^{-7} M$ aliesterase
DFP	Heated	$< 0.5 \times 10^{-9} M$	$1.4 \times 10^{-9} M$ pseudo cholinesterase
DFP	TOCP*	$< 0.5 \times 10^{-9} M$	$1.7 \times 10^{-9} M$ pseudo cholinesterase

* TOCP = tri-*o*-cresyl phosphate.

The I_{50} values obtained with DFP indicated an apparent enzyme concentration of 6.0×10^{-8} *M* aliesterase in a solution of normal rat serum which gives 1 unit of activity toward tributyrin. With the particular sample of pooled female rat serum used, the aliesterase activity toward tributyrin was 1390 μl CO_2/ml serum/20 min, as compared with the pseudo-cholinesterase activity of 180 μl CO_2/ml/20 min toward benzoylcholine. Thus a concentration of 4.6×10^{-7} *M* DFP should inhibit the aliesterase in a solution giving 1 unit of activity toward benzoylcholine, whereas the pseudo cholinesterase should be inhibited by 6.5×10^{-7} *M* DFP (Table 1). Apparently the DFP combines preferentially with the aliesterases of rat serum, and the pseudo cholinesterase is inhibited only by the surplus of DFP remaining after the aliesterase has been completely inhibited.

To test this hypothesis, the aliesterase was selectively destroyed in two ways: first by heating the native serum at 53° C for 60 min; and, second, by the intramuscular injection of 10 mg tri-*o*-cresyl phosphate/100 g body weight into female rats (*6, 7*). In both cases the aliesterase activity toward tributyrin was reduced to 1–2% of the former value, whereas most of the pseudo-cholinesterase activity remained unimpaired. And in both cases the elimination of the aliesterase from the serum solution resulted in a forty- to fiftyfold increase in the sensitivity of the pseudo cholinesterase toward DFP (Table 1).

Thus it can be concluded that the high concentration of DFP necessary to inhibit the pseudo cholinesterase in normal rat serum is due, in part at least, to the fact that the DFP combines preferentially with other proteins in the serum—namely, the aliesterase. Although the aliesterases of some other types of serum (e.g., of human serum) are not sensitive to inhibition by low concentrations of DFP (*6, 8*), it is still possible that other enzymes or protein groups might interfere with the reaction between DFP and pseudo cholinesterase in the same way. Inhibitors such as eserine, prostigmine, and analogs, on the other hand, appear to be relatively specific for the cholinesterases. It seems probable that the use of DFP may enable the determination of cholinesterase concentration in highly purified preparations of the cholinesterase (*9*), but the results obtained with crude enzyme preparations cannot always be relied upon, since the presence of other hydrolytic enzymes may protect the cholinesterases against inhibition by DFP.

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The Hall Effect and Electrical Resistivity of Tellurium[1]

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At low and high temperatures, tellurium is a P-type semiconductor, but in samples of adequate purity there is a range of temperatures within which the sign of the Hall coefficient is negative. This anomalous behavior, which has been noted by several observers (*1, 2*), has been studied in very pure tellurium prepared by multiple fractional distillation in an atmosphere of helium.

Fig. 1 shows the behavior of the Hall coefficient R, for samples of varying degrees of purity. Curve A is from a sample of c. p. grade tellurium containing an extrinsic carrier concentration of about 10^{18} carriers/cm^3. Curve D is for a sample containing about 10^{15} carriers/cm^3. The remaining curves are for samples of intermediate degrees of purity.

In all samples containing fewer than about 10^{17} carriers/cm^3, R is negative within a certain range of temperature. At low temperature R is always positive, changing to negative at a temperature which depends upon the extrinsic carrier concentration. R remains negative between this point and the temperature 230° C near which the sign becomes positive again and remains so to the melting point. The upper reversal temperature is fixed at approximately 230° C, but the lower reversal temperature is related to the carrier concentration by the empirical relationship

$$\ln R' = A + b/T_r,$$

where R' is the value of the Hall coefficient in the exhaustion range, T_r is the temperature of reversal, and a and b are constants.

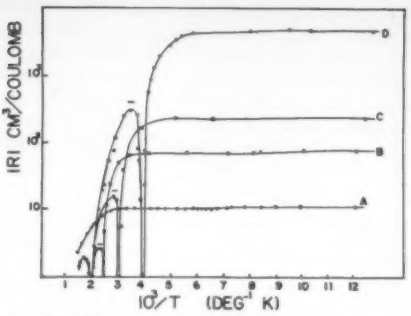

FIG. 1. The Hall effect in tellurium. The logarithm of the Hall constant R is plotted against $1/T$.

In samples cut from single crystals of tellurium, neither the value nor sign of R depends upon the orientation of the sample with respect to the magnetic field or crystallographic axes. Measurements of the Hall effect made with an a-c method show that the anomalous behavior is not due to the Ettingshausen effect. This conclusion has also been verified by direct measurement of the thermoelectric power and Ettingshausen coefficient.

Fig. 2 shows the resistivity as a function of temperature for a number of polycrystalline samples. The intrinsic resistivity at 27° C is approximately 0.5 ohm-cm, but an exact value cannot be given because

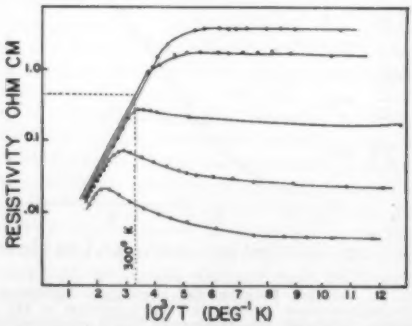

FIG. 2. The resistivity of tellurium measured in polycrystalline samples. Logarithm of the resistivity in ohm-cm plotted against $1/T$.

[1] Based on Ph.D. thesis, Purdue University.
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[3] Work carried out under contract with the Signal Corps.

of variations depending upon the preferred orientation of the crystallites in the sample. From the slope of the ρ vs. $1/T$ curve in the intrinsic range, the width of the forbidden band is found to be $0.33 \pm .01$ ev.

The resistivity has also been measured in samples in the form of single crystals. At 27° C the resistivity is 0.56 ohm-cm in the direction perpendicular to the principal axis, and 0.29 ohm-cm in the parallel direction. Since the samples on which the measurements were taken were well into the intrinsic range at room temperature, these values, which are much higher than those previously reported (*3, 4*), may be taken as characteristic of pure tellurium.

A complete report, including measurement of the thermoelectric power and Ettingshausen coefficient, is being prepared for publication.

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Interpretation of the Double Reversal of the Hall Effect in Tellurium

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The double reversal of the Hall effect observed in high purity tellurium samples cannot be explained by conventional semiconductor theory. Bottom (*1*) has shown that the temperature T_r of the reversal at low temperature depends on the concentration of impurities N_{ex}[2] and obeys the usual condition for the Hall constant to become zero.

$$\ln \frac{N_{ex}}{T_r^{3/2}} = \ln \left\{ A \frac{c^2-1}{c} \right\} - \frac{\Delta B}{2kT_r} \qquad (1)$$

c is the ratio of electron to hole mobility, ΔB is the width of the energy gap, and A is defined by the relations

$$n' = AT^{3/2} e^{-\Delta B/2kT}, \qquad (2)$$

where n' is the concentration of holes or electrons in a pure, intrinsic semiconductor, k is the Boltzmann constant, and T is the absolute temperature.

The higher reversal temperature, as Bottom (*1*) has shown, is independent of impurity content and is the same for all samples. This can be explained if one considers the number of lattice defects[3] N_D/cm^3, which in turn depend on the temperature T and on the activation energy of the defect W.

$$N_D = \alpha N_L e^{-W/kT} (2). \qquad (3)$$

α is determined by the ratio of lattice defects N_D to lattice sites N_L and is of the order of unity. This equation describes the number of lattice defects introduced in germanium by quenching from elevated temperatures (*3*).

$$W = E + \frac{\delta E}{\delta T} T. \qquad (4)$$

The temperature coefficient of W, suggested by Fan, takes into account a change in the binding energy due to thermal expansion.

The lattice defects are known to give rise to localized states which may act as acceptors (*4–6*). We can set, therefore, approximately

$$N = N_{ex} + N_D, \qquad (5)$$

and N is constant in the temperature range where N_D is negligible, but will follow the exponential law (*3*) if N_{ex} becomes very small compared with N_D. The conductivity σ can now be written as

$$\sigma = eb_2[n'(c+1) + N_{ex} + N_D], \qquad (6)$$

where e is the charge of the electron, b_2 the hole mobility, and the other letters have the significance indicated above.

Depending on the temperature range, the conductivity will first be determined from Eq. (2), and at higher temperatures, from Eq. (3). Middleton (*7*) found in one sample a second high temperature slope of the log ρ vs. $1/T$ plot. The slope was $8352/T$; and if this is to be attributed to the defects at these high temperatures, one obtains $E = 0.72$ ev.

The condition for zero Hall constant becomes now

$$n' \left(\frac{c^2-1}{c} \right) = N_{ex} + N_D. \qquad (7)$$

For a quantitative analysis, the mobility ratio c has to be determined. It was obtained from the ratio of the negative maximum of the Hall constant R_{max} and the Hall constant at exhaustion R_{ex}, and an analysis of the scattering mechanism in the exhaustion and transition ranges. In this way one obtains $c = 1.7$.[4]

Using Eq. (1) we obtain $\Delta B = 0.36$ ev, and $A = 1.55 \times 10^{15}$.

If in the high temperature range N_{ex} is small compared with N_D, one has for the second reversal at $T = 500°$ K

$$n' \frac{c^2-1}{c} = N_D. \qquad (8)$$

For $N_{ex} > 3 \times 10^{17}$ per cc the Hall constant remains positive throughout the whole temperature range. For $N_{ex} \backsim 1.2 \times 10^{17}$ per cc the Hall constant becomes very small and might reach zero at about $T = 480°$ K. Double reversal occurs only if $N_{ex} < 10^{17}$ per cc. The temperature of the lower reversal is then mainly governed by N_{ex}; the temperature of the higher reversal occurs at $T = 500°$ K independent of N_{ex}.

[1] Present address: University of Goettingen, Germany.

[2] We call the number of impurities N_{ex}: the number at exhaustion when all impurities are ionized.

[3] The author learned only after completion of his paper that this fact was first realized by W. Schottky (in a letter Feb. 2, 1950, to K. Lark-Horovitz). Schottky has even called this behavior a new type of "intrinsic conductivity," where the temperature dependence in the high temperature range corresponds to the formation and dissociation of a *Te* vacancy plus hole.

[4] We have assumed this mobility ratio as constant up to the temperature of the second Hall reversal.

Fig. 1 illustrates this behavior. We have plotted N_D vs $1/T$, giving the temperature dependence of defects. We have also plotted n' vs. $1/T$, which gives essentially the intrinsic slope and $n'\frac{c^2-1}{c}$, which is parallel to the line representing n'. The concentration of impurities at exhaustion is indicated for various tellurium samples measured by Bottom and others (*8*).

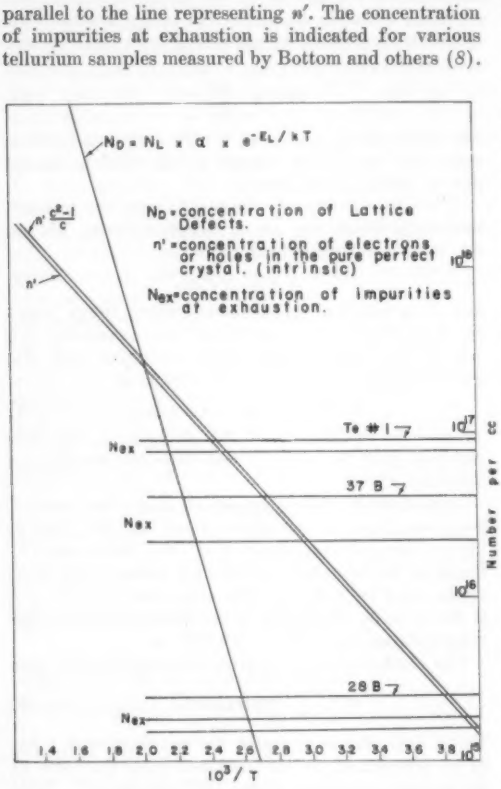

FIG. 1.

The intersection of the lines N_{ex} = constant with $n' \times \frac{c^2-1}{c}$ gives the low temperature reversal. The intersection of N_D with $n'\frac{c^2-1}{c}$ gives the high temperature reversal.

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Red Blood Cell Studies: Ashby Curves[1]

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Important information about the nature and life span of red cells is obtained by the differential agglutination method of Ashby (*1*). All curves at present available can be explained by assuming (*a*) that normal red cells undergo a period of wearing or aging which precedes their eventual breakdown, and (*b*) that the worn or aged red cells are broken down by a random, first order process. The wearing times of individual cells would in general be different, but in the present treatment it is assumed that all the red cells of any one person have the same wearing time. It is also assumed that the rate of breakdown of worn cells is characteristic of their environment.

If it is further assumed that a representative steady state population is transfused, it follows that the number of wearing cells remaining at time t is

$$w = \begin{cases} Y(0)\,(t_1 - t)/(t_1 + K_1), & 0 \leq t \leq t_1 \\ 0, & t_1 \leq t, \end{cases}$$

if $Y(0)$ = number of transfused erythrocytes, t_1 = their wearing time (which for simplicity is assumed to be the same for all transfused cells), and K_1 = the average lifetime of worn cells *in the donor*.

On letting y = the number of worn cells remaining at time t,

$$K_2 \frac{dy}{dt} = \begin{cases} K_2 Y(0)/(t_1 + K_1) - y, & 0 \leq t \leq t_1 \\ -y, & t_1 \leq t \end{cases}$$

if K_2 = the average lifetime of worn cells *in the recipient*. These K's are therefore the reciprocals of the corresponding turnover rates for the random breakdown. Since $y = K_1 Y(0)/(t_1 + K_1)$ at $t = 0$ and since $Y = y + w$, the final solution of the differential system is

$$Y = \begin{cases} \left(\frac{Y(0)}{t_1 + K_1}\right) \cdot [t_1 - t + K_2 + (K_1 - K_2)\exp(-t/K_2)], & 0 \leq t \leq t_1 \\ Y(t_1)\exp(-(t - t_1)/K_2), & t_1 \leq t \end{cases} \quad (1)$$

where $Y(t_1) = \left(\frac{Y(0)}{t_1 + K_1}\right)[K_2 + (K_2 - K_1)\exp(-t_1/K_2)]$,

so that if $t_1 \gg K_2$, $Y(t_1) \left(\underset{\text{approx}}{=\!=}\right) K_2 Y(0)/(t_1 + K_1)$.

For donors in diseased states (such as sickle cell anemia, congenital hemolytic anemia, and acquired hemolytic anemia) in which $\left(\underset{\text{approx}}{t_1 = 0}\right)$, Eq. (1) becomes:

$$Y = Y(0)\exp(-t/K_2). \quad (2)$$

Normal cases are readily interpreted on the basis

[1] Sponsored by the Veterans Administration and published with the approval of the chief medical director. The statements and conclusions published by the authors do not necessarily reflect the opinion and policy of the Veterans Administration.

of Eq. (1), and this is illustrated by the three schematic curves of Fig. 1. The successive steps of curve

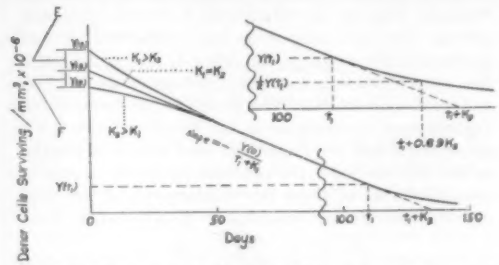

FIG. 1. Three normal schematic Ashby curves of donor red blood cells in the recipient, with magnification × 2 of the tail.

analysis are the determinations of (*a*) time t_1 (at which the curvature starts to increase); (*b*) intercept $(t_1 + K_2)$ (and hence K_2 by subtracting the t_1 of $[a]$); (*c*) the linear slope $-Y(0)/(t_1 + K_1)$ (and hence K_1 by subtracting t_1 of $[a]$ from $Y(0)$ times the negative reciprocal of this slope); (*d*) the half-life on the tail $(t_1 + 0.69\,K_2)$ (and hence a check on K_2 by subtracting the t_1 of $[a]$); (*e*) the agreement between Y (t_1) and $\dfrac{K_2 Y(0)}{(t_1 + K_1)}$; and, if $K_1 \neq K_2$, (*f*) the agreement between E (or F) and $(K_1 - K_2)Y(0)/(t_1 + K_1)$. The last three items check the preceding determinations.

Typical experimental curves (*2–5*) yield results of 100–110 days for the wearing time t_1 and of 15–40 days for the average life of worn cells. These results of the present interpretation agree with the conclusions of earlier interpretations in which the curve was linear at the beginning and in which the intercept $(t_1 + K_2)$ was said to give the life span of the donor's red cells (since $K_1 = K_2$ in these cases). It is to be noted that the survival time of the donor cells, *in the donor*, is $Y(0)$ times the negative reciprocal of the slope of the linear portion of the curve.

The present interpretation also explains why some of the normal curves are not linear near the beginning—in terms of the different rates of random breakdown in the donor and recipient environments (each of which is determined explicitly when $K_1 \neq K_2$).

In case the donor has sickle cell anemia (*6, 7*), congenital hemolytic jaundice (*8*), or acquired hemolytic anemia (*2, 5, 8*), the wearing time t_1 is negligible and the results are expressed by Eq. (2). This expression is linear when it is plotted on semilogarithmic paper because log Y is in this case a linear function of time. On measuring this semilogarithmic plot with a ruler, one finds that K_2 is the number of multiples of 2.30 days corresponding to each power of 10 through which Y changes.

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The Ultracentrifugation of Soluble Cytochromes[1]

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A particulate preparation of mammalian heart muscle dissolved with the aid of sodium desoxycholate has been studied in the ultracentrifuge.[2] The method of preparation and the visible absorption spectra have been previously described (*1*). The designation Preparation O-4 refers to the amount of sodium desoxycholate used to dissolve the proteins. As pointed out previously, there is evidence that the cytochromes *b*, *c*, and oxidase are present in this preparation.

A concentrated solution of the lyophilized Preparation O-4 was made by dissolving each "ml equivalent"[3] in 1 ml water. It was centrifuged at $260{,}000 \times g$ (59,780 rpm) for 150 min. At this time, the preparation contained one slow-moving boundary. The ultracentrifuge was stopped, using the rapid brake, and the upper two thirds of the contents of the cell were removed for spectral analysis. The solution was transferred to a microcuvette (*2*) of the spectrophotometer,[4] reduced with $Na_2S_2O_4$, and covered with mineral oil for spectral analysis. The curve presented in Fig. 1 indicates that a small amount of cytochrome oxidase is present (the 603-mμ peak), but that the principal component is cytochrome *c* (the 550- and 520-mμ peaks). All the cytochrome *b* and most of the cytochrome oxidase have sedimented. Cytochrome *c*, therefore, is the most slowly sedimenting chromoprotein.

In another experiment the concentrated solution of the enzyme was reduced with $Na_2S_2O_4$ before being introduced into the ultracentrifuge cell. This was accomplished by filling the cell with the oxidized preparation (at which time the last bubble was removed) and by layering the reduced preparation on the bottom of the cell, thus forcing the oxidized preparation

[1] A preliminary centrifugation of a Preparation 2-3 (*1*) was done for us by Lawrence J. Milch, USAF, School of Aviation Medicine, Randolph AFB, San Antonio, Texas. We wish to thank Major Milch for his willing collaboration. This investigation was supported in part by a research grant from the Division of Research Grants and Fellowships of the National Institutes of Health, U. S. Public Health Service.

[2] We thank L. Robinson Hyde for assisting and instructing us in the use of the Spinco instrument.

[3] One "ml equivalent" represents the amount of dry preparation obtained by lyophilizing 1 ml of the original supernatant.

[4] The Beckman spectrophotometer was made available through the courtesy of Arnold Lazarow.

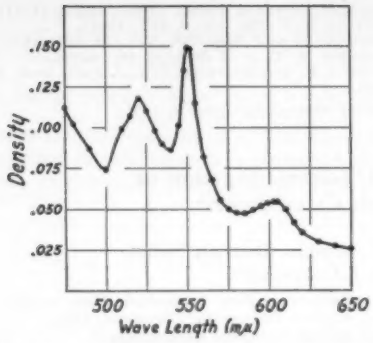

FIG. 1. Spectrum (reduced) of the upper two thirds of the contents of the ultracentrifuge cell after 150 min at 260,000 × *g*.

out at the top. After 70 min at 260,000 × *g* (59,780 rpm) the ultracentrifuge was stopped in the following way to minimize mixing of the contents: the rapid brake was applied to 30,000 rpm, the slow brake to 5,000 rpm, and then the head was allowed to coast until it had come to rest. A photograph taken at 30,000 rpm (74 min) represents approximately the position of the boundaries when the centrifuge had come to rest (Fig. 2). There are at least four components present. The head was detached, and the cell was cautiously removed and placed in a spectrophotometer carrier that had previously been adapted to this use.[5] The spectra were determined at four levels corresponding to positions 9½, 7, 4½, and 2 mm above the floor of the cell, as indicated approximately by the arrows above the numbers 1, 2, 3, and 4 in Fig. 2. The holes, each 1 mm in diameter, were drilled into a slide which was placed between the slit

[5] Details will be furnished on request.

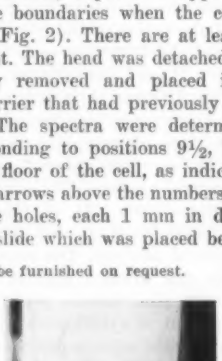

FIG. 2. Sedimentation pattern corresponding approximately to the relationships prevailing with the head at rest. Arrow 1 indicates approximately the position of the hole nearest the top of the cell when the spectra were taken. Time, 74 min; speed, 59,780 rpm (photo taken at 30,000 rpm); cell vol, 0.8 ml; temp, 22°; bar angle, 50°; exposure time, 20 sec; filter, Wratten #16; buffer, 0.1 *M* $Na_2HPO_4 \cdot KH_2PO_4$; pH, 7.4.

and the centrifuge cell. The four curves are presented in Fig. 3. Curve 1 represents the spectrum obtained through the hole nearest the top of the cell. There is little or no cytochrome *b* at this level, suggesting that this component has sedimented. A comparison of the curves in the order 1, 2, 3, and 4 shows that cytochrome *b* is nearer the bottom of the cell than is cytochrome oxidase. The peaks at 530 and 560 mμ (cytochrome *b*) increase as the bottom of the cell is approached and are prominent on Curve 4 in relation to the 603-mμ peak (cytochrome oxidase). It can be concluded that of these two chromoproteins the more rapidly sedimenting component is cytochrome *b*.

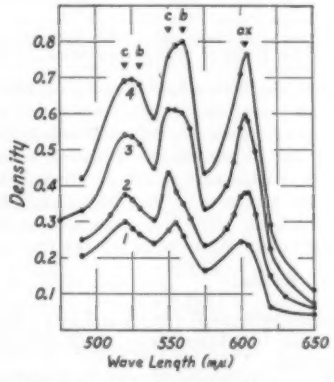

FIG. 3. Spectra at four levels in the ultracentrifuge cell of the reduced Preparation O-4 after 74 min at 260,000 × *g*. Curve 1 obtained through the hole nearest the top of the cell.

An inspection of the peak of cytochrome oxidase on the several curves of Fig. 3 shows a symmetry about 603 mμ. There is no evidence here for the separation of cytochrome oxidase into two components.

From a series of photographs taken of the sedimenting components, it has been calculated that the fastest moving boundary, probably representing cytochrome *b*, has an uncorrected sedimentation constant of 6.5×10^{-13} sec. The second and third boundaries have uncorrected constants of 5.8 and 5.2×10^{-13} sec, respectively. The slowest moving boundary, probably representing cytochrome *c*, has an uncorrected constant of 1.2×10^{-13} sec. This last value is to be compared to the published, corrected value of 1.9×10^{-13} sec obtained by Pedersen and Andersson (*3*) for cytochrome *c*.

In conclusion, it is to be noted that cytochrome *b* is the most rapidly sedimenting component, cytochrome oxidase is intermediate, and that cytochrome *c* sediments most slowly.

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Widespread Distribution of *Delacroixia coronata* and other Saprophytic Entomophthoraceae in Plant Detritus

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Delacroixia coronata (Cost.) Sacc. & Syd. (*1, 2*) is one of the few species in the Entomophthoraceae which, unlike the many insect parasites belonging in that family, develop well on various artificial media commonly used for cultivating microscopic fungi. When planted on Petri plates of a fairly transparent medium like maize meal agar it reveals vigorous mycelial growth, abundant formation of large globose conidia singly on aerial conidiophores, forcible projection of these conidia some distance from their place of origin, frequent germination of a conidium by emission of a vegetative germ tube, and equally frequent germination by production of a globose secondary conidium on a short, stout aerial outgrowth. It often shows also, though in greatly varying measure, a more distinctive type of reproduction wherein a large globose conidium will simultaneously put forth plural—usually about a dozen—short outgrowths, and on them will give rise terminally to a corresponding number of spores, all markedly and in about equal degree smaller than their parent. Although this multiplicative reproduction, which led Costantin to erect a separate genus for the fungus, may have lost some value as a diagnostic character through its observed occurrence also in *Conidiobolus brefeldianus* Couch (*3*), it has gained significance with respect to the basic morphology of the family through the discovery of two parasitic species, *Meristacrum asterospermum* Drechsl. (*4*) and *Ballocephala sphaerospora* Drechsl. (*5*), that reproduce asexually by giving rise only to small conidia. In disclosing the large conidium as a sporangium with a manner of spore development somewhat like that of *Cunninghamella*, the multiplicative reproduction of *D. coronata* establishes the small-spored forms as primitive members of the Entomophthoraceae. The resemblances of *M. asterospermum* to *Gonimochaete horridula* Drechsl. (*6*), which produces endogenous immotile spores in aerial hyphal outgrowths, seem suggestive of remote phylogenetic connections of the family with lagenidiaceous types, such as *Protascus subiliformis* Dang. (*7*) and *Haptoglossa heterospora* Drechsl. (*4*), that form endogenous immotile spores, presumably homologous with zoospores, in submerged intramatrical thalli.

D. coronata has been encountered at firsthand so infrequently that it is generally regarded by mycologists as a rare species. During 30 years it has appeared adventitiously in my cultures only four times. More recently, however, a procedure designed especially for isolating microscopic fungi that commonly produce their spores in a short time and soon shoot them off forcibly has shown the species to be virtually ubiquitous in leaf mold and in other kinds of plant detritus resulting from exposure of vegetable materials to slow decay in moist contact with the ground. In this procedure samples of detritus are first freed of their coarser components. Portions of the finer friable residue are then fastened with soft agar to the underside of a lid from a sterilized Petri dish. By gently kneading the mixture of detritus and agar all particles of decaying material are thoroughly moistened and thus made to adhere firmly enough to remain in position when the lid is turned right side up. The whole central area of the lid may advantageously be

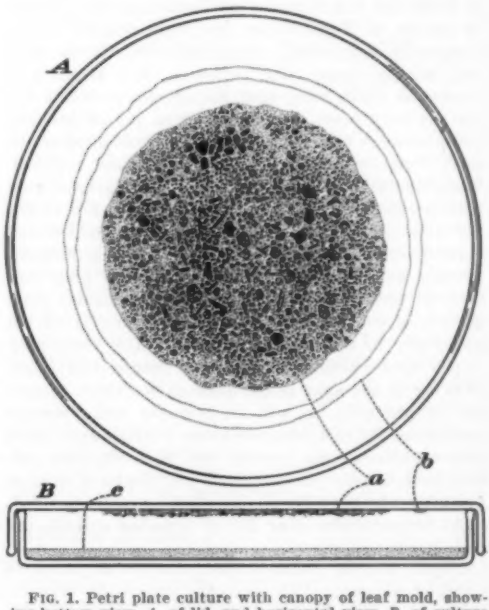

FIG. 1. Petri plate culture with canopy of leaf mold, showing bottom view, *A*, of lid, and horizontal view, *B*, of culture with lid in position: *a*, adhering puddled mixture of leaf mold and soft agar; *b*, circular barrier of soft vaseline or heavy mineral oil; *c*, layer of agar culture medium. Approx ×.75.

planted with detritus (Fig. 1, *a*), but an outer zone about 15 mm wide should be left clean and as nearly sterile as possible. If small particles have fallen into the clear zone the whole outer area should be wiped with a sterile cotton plug slightly moistened in alcohol. Should the detritus appear rather badly infested with mites or other minute crawling animals it may be expedient to restrict their wanderings by applying soft vaseline or heavy mineral oil in a circular band (Fig. 1, *b*) around the central area. The lid is then gently placed on the lower half of a sterilized Petri dish containing a firm plate of moderately transparent, sterile agar culture medium (Fig. 1, *c*). Wherever *D. coronata* is present in the canopy of moist vegetable detritus it produces conidiophores from which conidia are forcibly propelled. After falling on the agar below, many of the conidia germinate vegetatively, thereby giving rise to scattered mycelia. As

these mycelia are usually free of alien organisms they readily yield pure cultures when transferred to sterile agar slants. More than a dozen pure cultures, all originating from separate conidia, may often be obtained from a single Petri plate within 2 days after it has been covered with a detritus canopy.

In addition to *D. coronata* other members of the Entomophthoraceae capable of "saprophytic" growth develop in canopied plate cultures, though in lesser quantity. The genus *Conidiobolus* would seem only meagerly represented in the collection of cultures isolated from leaf mold taken up in different localities in Maryland and Virginia late in the autumn of 1951. A species of *Basidiobolus* has been obtained rather frequently from dark, soggy leaf mold taken from wet, wooded areas near Beltsville, Md. When it is grown on maize meal agar the species produces numerous zygospores with the curious paired beaklike protuberances long familiar in textbook illustrations of *B. ranarum* Eidam (*8*), though the thick wall surrounding the individual zygospore seems always completely colorless. Its asexual reproduction has so far not been observed directly, yet some production and forcible discharge of conidia must in each instance precede its appearance in a canopied agar plate culture. Moreover, when a sizable slab of maize meal agar occupied by its vegetative mycelium is affixed adhesively to the ceiling of a Petri dish containing sterile agar culture medium, the fungus will begin growing in the agar below quite as certainly, though not as promptly, as will *D. coronata* under similar conditions. By such affixture above a sterile agar plate entomophthoraceous mycelia that in a canopied culture have become contaminated with bacteria or been overgrown by alien fungi may often be easily purified.

At temperatures near 20° C mycelial strands extended downward here and there from a canopy of detritus, mainly by members of the Mucorales, will usually reach the agar floor in 2½ or 3 days after the culture was prepared. The culture thereupon becomes rather quickly overgrown by miscellaneous microorganisms and soon is greatly impaired in usefulness, if not utterly ruined. Success in isolating entomophthoraceous forms by the procedure here recommended must be achieved early. Newly collected moist detritus should, as a rule, provide most rapid development. However, material collected in an air-dry or nearly air-dry condition has given very satisfactory results for several months—far better results than moist or wet material that after being collected was kept in a tight container in a warm laboratory for 2 or 3 weeks before it was used. The pronounced deterioration of the material in the tight container evidently resulted from excessive development of species of *Trichoderma, Aspergillus,* and *Penicillium,* as well as of members of the Mucorales, during the brief period of storage. Where moist plant detritus cannot be used immediately the saprophytic entomophthoraceous forms and other components of its natural microflora, including many predaceous and parasitic fungi destructive to rhizopods and eelworms, can be preserved fairly well by allowing it to dry out slowly at relatively low temperatures.

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Comments and Communications

Antibiotics and Immunodesensitization in the Treatment of Human Brucellosis

The new antibiotics—streptomycin, aureomycin, chloromycetin (Cloramphenicol), and terramycin—which have a strong inhibitory action against *Brucella,* have been used in the treatment of human brucellosis with satisfying and prompt, but not lasting results. The authors believe that an antibiotic's success in the treatment of any infectious disease depends upon an efficient and prompt immunological response of the body against the infection, in order to continue and consolidate the inhibitory action when the antibiotic is stopped. In brucellosis the natural immunological response to the infection is slow and late; for this reason, when the action of the antibiotic is suspended, the infection advances anew, regardless of the strength of the drug, and acute relapses occur or the disease takes a chronic course. For these reasons the authors have considered it necessary to stimulate artificially the development of immunity simultaneously with the administration of the antibiotic (Chloramphenicol). In brucellosis there is a condition of allergy; hence it is not possible to give the antigen in doses as large and as frequent as would be desirable for a prompt immunological response, without causing violent hypersensitivity reactions. Thus it is necessary to give small, slowly absorbed, progressively increasing doses of a species-specific antigen, in order to desensitize and at the same time stimulate the development of immunity. The authors give the name of immunodesensitization to this method.

In 480 cases of brucellosis so treated, the allergy to *Brucella,* as shown by the intensity of the skin reaction to the intradermal injection of the antigen, decreased notably or eventually disappeared, as compared with an equal number of nontreated cases in which the allergy persisted or increased indefinitely.

In 97 treated cases the opsonic index increased to proportions of immunity from 1 to 6 months after treatment, whereas in 113 nontreated cases this index stayed low or moderate (index of infection) during all the time of illness, even in those patients who had been ill for several months or years. In 101 treated cases the titers of the complement fixation test to *Brucella melitensis* increased significantly, as compared with those of 159 nontreated cases. In 79 cases treated with Cloramphenicol and immunodesensitization, the fever disappeared in an average of 3 days, and the other symptoms in some weeks. There were only 6.3% relapses in an average observation period of 11.4 months, as compared with 12–66% relapses reported by workers who have used the same antibiotic but without the immunodesensitization, in an observation period of 3 months. From the results obtained, it has been concluded that (1) allergy decreases and resistance increases to *Brucella* in cases of brucellosis treated by the immunodesensitization method of the authors; (2) results are significantly better in cases of brucellosis treated simultaneously with some antibiotic (Cloramphenicol) active against *Brucella* and with the immunodesensitization, than if the antibiotics are used alone.

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A Flat, Adjustable Lantern Slide Carrier

THE usual case for carrying lantern slides is awkward to handle or pack in luggage. The slide carrier pictured here is convenient for carrying up to 18 slides in a brief case. It is approximately $9\frac{1}{4}'' \times 11\frac{3}{4}'' \times \frac{3}{4}''$ and, without slides, weighs about $1\frac{1}{4}$ pounds. The case is made from $\frac{1}{8}''$ pressed board and consists of a flat bottom and a hinged cover enclosing one, two, or three frames.

Fig. 1 indicates the construction. The bottom is a single piece of pressed board. Each frame is made from four strips of the pressed board cut $\frac{3}{8}''$–$\frac{1}{2}''$ wide so as to leave an interior space sufficient to accommodate 6 slides. For the usual $4'' \times 3\frac{1}{4}''$ slide this space will be $8\frac{1}{8}'' \times 9\frac{7}{8}''$, but slides vary slightly in size according to their binding, and the space to be allowed will depend on the particular type of slide used. A finger hole, cut in the frame, as indicated, facilitates removal of the slides. The first frame may be glued to the bottom or attached to it by screws. The second and third frames, to be removable, should be screwed into place, with the screws staggered from the set below. The single-frame carrier will hold 6 slides. With two and three frames the device will hold 12 and 18 slides, respectively. The cover is attached to a $\frac{5}{8}''$ strip, by hinges, held with machine screws, which are countersunk on the underside. A fabric hinge could be used to replace the metal hinges, thus eliminating the projecting metal parts, A clasp is formed from a small piece of aluminum, and a nail

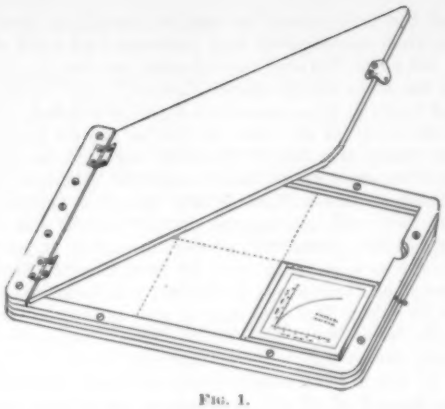

FIG. 1.

slides through it to hold the cover shut. When 2 or 3 layers of slides are carried, a thin piece of cloth may be placed between each layer, although the slide binding serves fairly well to hold the slides apart. When an odd number of slides is to be carried, a few pieces of pressed board cut to the size of the slides may be used to fill in.

Although the device and design are fairly obvious, we have not seen any similar slide carrier. It has attracted much favorable comment and has been very handy both for carrying and for mailing slides.

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Japanese Illusion

JEAN BOULWARE'S modification of the Japanese illusion (SCIENCE, **114**, 584 [1951]) would probably be fun at a mixed party, but for ordinary purposes the age-old children's method of performing it, in which two persons place their (contralateral) hands together palm to palm, is a great deal simpler and works just as well. Indeed, it permits several interesting variations to be performed more easily than the suggested method does.

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Homing Not Hindered by Wing Magnets

H. L. YEAGLEY (*1*) proposed a theory and reported experiments from which he concluded that homing pigeons are able to orient themselves and find their way over unknown territory by being able to perceive the effects of the earth's magnetic field and the Coriolis force. Both theory and experiments have been criticized on various grounds (*2, 3*). This note reports a repetition of Yeagley's magnetic wing experiment.

In his experiment Yeagley used 20 young pigeons

that had been trained to home to the loft at Paoli, Pa., from release points west, northwest, and north up to 100 miles. The birds were divided into two groups. To the wings of 10, copper plates 1″ × .218″ × .025″ and weighing approximately 0.8 g were attached, and to the wings of the other 10, similar magnet plates. The theory held that, if the birds were able to perceive the effect of the earth's magnetic field and depended on this in homing over unknown territory, then those with nonmagnetic plates should be able to home in the normal way, whereas those with magnets would tend to be confused by the weak magnetic fields created by their wings in motion, and hence would not be able to find their way as well as the controls.

The birds were released 65 miles southeast of Paoli, one by one, with the following results: 8 out of 10 bearing the copper plates homed in the first two days; 6 of 10 with the magnets homed—one the first day, and five the fourth. It was concluded that these results upheld the theory that the birds were sensitive to the earth's magnetic field and made use of it in homing. It was a fact, however, that 5 of 6 of the birds carrying magnets returned with one or both missing, and this seemed to us to point to a flaw that invalidated the whole experiment. It is obvious that the method of attaching the plates must be one that is perfectly secure yet does not inconvenience or harm the birds, and it is equally important that the method of attachment must be identical for both sets of plates. The method actually employed was to tie the plates to the wings with silk strands threaded through the flesh between the third and fourth metacarpel bones. The results seemed to indicate that (1) the method was not dependable and that (2) it differed in some essential way for the two sets of plates.

D. A. Gordon (*2*) repeated the experiment with 60 homing pigeons between 3 and 6 months of age, which had been raised and "trained on several preliminary flights" at the Pigeon Breeding Center of the U. S. Army at Fort Monmouth, N. J. The birds were divided into three groups—24 carrying wing magnets, 24 with unmagnetized plates, and 12 with no plates. They were released from three points in unfamiliar territory, 36, 50, and 58 miles distant from the home loft. Every bird used in the experiment returned by nightfall of the day of release, and the birds with magnets returned as quickly as the others. The method of attaching the plates was to glue them with Duco cement to the underside of the manus portion of the wings. None of the plates fell off during the experiment.

The birds used in the foregoing experiment had a minimum of basic training and flying experience, and the points of release were not very distant from the home lofts. It seemed to us, therefore, that it might be interesting to repeat the experiment with racing pigeons of proved ability and with a great deal of experience in training and racing flights along a straight course in one direction; and, in the experimental flight, to take them far enough into unfamiliar territory to make the homing test a severe one.

Clarence Morris, 1951 champion flyer of the Denver Homing Pigeon Club, supplied 12 birds from his young-bird race team. The birds were 7 to 8 months of age; their training had started in July, and all had flown the intermediate stations up to 100 miles several times; 100 miles, 4 times; 200 miles, once; and 3 of them had flown 320 miles. In addition we had 4 birds from the Van Riper loft—3 yearlings that had had approximately the same experience as the Morris young birds in two successive years up to 320 miles, and one 1947 hen that had homed from 500 miles twice. The course over which these birds had been flown extends to Denver from points in northern Colorado, Wyoming, and southern Montana. It should be borne in mind that always in training and racing these birds had been released early in the morning with the sun in the east and the Rockies visible in the west.

On November 8, 1951, we placed control plates on all the birds, and they were exercised daily. The plates were attached with fine copper wire to the inside of quills of the seventh or eighth primaries (as numbered by pigeon fanciers, who count the primaries in the order of the molt, the reverse of ornithological practice). Some experimenting had shown this to be a dependable method which did not bother the birds. On November 16 magnets were substituted for brass plates on 8 of the birds, and the following morning they were released at 5-min intervals from the State Game Farm northeast of Colorado Springs and about 70 miles *south* of Denver. The weather was fair and remained so for the following two weeks. It did not surprise us that, on release, every bird (with one exception) flew south toward Colorado Springs—sun in the east, mountain range to the west, and a city in sight, since their exercise flights had always been over a city.

No birds homed the first day, indicating that all were thoroughly lost. Morris received 5 the second day—2 with magnets and 3 with control plates—and 2 the third day, both with magnets. Van Riper received 1 the fourth day and 1 the fifth, the first with control plates and the second with magnets. No birds were received thereafter up to December 1. One Morris bird and 1 Van Riper bird returned with a control plate missing; all others were intact.

In this experiment 4 of 8 controls and 5 of 8 with magnets homed; hence no difference in homing ability between the two lots is indicated. Three of the Morris birds and 2 of the Van Riper birds had shown marked superiority in racing. These all returned. Two bore magnets and 3 control plates.

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Book Reviews

Cottrell—Samaritan of Science. Frank Cameron. New York: Doubleday, 1952. 403 pp.; index. $4.50.

Frederick Gardner Cottrell was an accomplished scientist, a catalyzer of scientists, and a benefactor of science. But above all he was a man of integrity who steadfastly refused to compromise his ideals and whose vision for mankind was frequently ahead of his times. This is a clear account of his life and work which practically all scientists—and many in other fields—may read with interest and profit.

Cottrell was born in Oakland, California, on January 10, 1877. After a boyhood in which he exhibited much ingenuity and a flair for things scientific, he entered the Chemistry Department of the University of California. Here, his dynamic and original approach to problems jolted many instructors out of the worn paths of the textbooks into the trackless jungle of original investigation, and his broad interest in many fields earned from one professor the caustic comment, "Cottrell wanders all over the lot."

After graduation, Cottrell set out for Germany for additional study, visiting most of the important university and industrial laboratories en route. At first, he studied with van't Hoff at the University of Berlin. Later he worked in the laboratory of Ostwald at Leipzig, receiving his Ph.D. degree there after solving a difficult problem which many of his fellow-researchers had refused to tackle, and one which had baffled even Ostwald himself. His Ph.D. examination was passed *summa cum laude,* and van't Hoff commended his thesis as remarkable for its "originality and vigor."

Back at the University of California as a member of the Chemistry Department staff, Cottrell threw himself into his own research program. Soon he had developed a method for the electrical precipitation of smoke, dust, and fumes which led him into industrial applications of his work. He later assigned the patents for this process to the Research Corporation, which he was instrumental in organizing as an agency for developing patents and making grants for basic research.

Cottrell also participated in the formation of the International Auxiliary Language Association, an organization that grew out of investigations undertaken after World War I by committees of the International Research Council, by the American, British, French, and Italian associations for the advancement of science, the American Council of Learned Societies, and other groups of specialists. Cottrell's interest in an international language dated back to 1902, when at a "student Sunday" social gathering at Ostwald's home a discussion of an international language had taken place.

After many years of industrial and governmental work, which took him many times to Europe and less frequently to Tokyo, Cottrell returned to California for his twilight years. Here he died on November 16, 1948, while attending a National Academy of Sciences meeting in Berkeley.

As Ernest O. Lawrence says in the foreword: "It is always an inspiration to oncoming generations to read about the lives of good men who, through their spirit as well as their works, make contributions of lasting importance."

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Range Management: Principles and Practices. Arthur W. Sampson. New York: Wiley; London: Chapman & Hall, 1952. 570 pp. $7.50.

The author has combined many years' experience in research, teaching, and observation to produce this comprehensive treatise. The book is written from both an academic and a practical viewpoint. The broad and inclusive subject of range management is covered under four subdivisions. In the first part, "Range Management in Perspective," the world's grazing practices and problems, physiological and ecological principles as applied to range management, characteristics of grazing lands, and the historical development of grazing in America are discussed.

"Native Range Forage Plants" consists of illustrations and descriptions of the more important range grasses, forbs, and shrubs. This subdivision includes a rather large amount of taxonomy and morphology and, although basically important to practical range management, may be considered by many to be out of place in a range management text. With the author's background of experience, the information presented here might well have been developed into a separate textbook on the taxonomic and morphologic characteristics and the grazing value of range plants.

"Improvement and Management of Range and Stock" includes those management practices—reseeding, noxious plant control, grazing systems, supplemental feeding, water developments—that are common to all livestock producers. Technical problems of range condition, forage utilization, range surveys, management plans, and the economic, physical, and social aspects of ranching are presented.

"The Protection of Range Resources and Range Livestock" is the subject of part four. Ways to avoid damage by livestock to timber reproduction, descriptions and pictures of poisonous plants, foraging and predatory wildlife of the range, soil erosion, and administration of the public grazing lands are included in this subdivision.

The objective of this book is to point out that care and management of the nation's range resources should be based on knowledge gained through years of observation, research, and scientific analysis. Broad principles, rather than specific applications, are outlined. Numerous illustrations, a bibliography at the end of each chapter, and definitions of terms

pertinent to the subject complete a book that will assist in promoting the science of range management. It will be a valuable addition to the libraries of botanists, physiologists, ecologists, teachers, students, range administrators, and livestock producers.

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Principles of Plant Physiology. James Bonner and Arthur W. Galston. San Francisco: Freeman, 1952. 499 pp. $5.50.

This book is a pioneer in what will undoubtedly become a widespread movement aimed at modernization of botanical texts too long steeped in the classical intuitive approach. Bonner and Galston have bravely stepped between the fire of the orthodox who cannot tolerate change and of the moderns who will carp at the lack of rigorous intellectual treatment and at the comic-book aspect of some of the illustrations.

Specifically, the authors have attempted a fusion of plant physiology with contemporary biochemistry, much of the latter unfortunately based more upon what is known about animals and bacteria than upon knowledge of plants. Their mode of approach is clearly outlined in the preface. Emphasis upon brevity, decisiveness, and basic principles was sought, and to ensure success in the search "detailed discussions of contradictory views [were] . . . avoided . . . in the hope that a clear conception of [e.g.] translocation will aid the student in organizing and remembering the facts relative to the subject." The authors admit that "such a treatment tends to become dogmatic," but by some curious turn of logic claim to have tried "diligently to avoid dogmatism." That the treatment is dogmatic by virtue of oversimplification can scarcely be doubted. That some degree of dogmatism cannot be avoided in a first enthusiastic attempt to wed the ingrained empiricism of plant physiology to the analytical approach of biochemistry is a certainty.

The physiological content of the text is by and large excellent, although one detects a natural tendency to emphasize those topics nearest the research interest of the authors' institution. Especially welcome are the elimination of lengthy, obscure tables and the substitution of graphs wherever it is possible to describe processes in quantitative terms. The graphs are well chosen and excellently rendered. Welcome also are the relegation of water relations of plants to a position commensurate with their comparative unimportance and the introduction of much modern material on growth.

Presentation of biochemical subject matter is difficult at the elementary level unless one can presume a thorough grounding in theoretical chemistry on the part of the student. The biochemical section of this text appears to be a watered-down version of the senior author's recent general treatment of the subject. Pedagogically, it is doubtful whether the beginning student will acquire a very clear and convincing conception of plant physiological chemistry even with the advantage of numerous, perhaps overly facile, chemical formulas and equations and the whimsical, five-armed ghostly enzyme of Evan Gillespie. In general, the use of illustrations, however competently drawn, at the expense of critically written text would seem to exceed the needs of even a picture-conscious generation.

Because this is a pioneering text and because it is obviously written with vigor and enthusiasm, it should be on the shelf of every physiologist and of those physical scientists who, in unguarded moments, wonder why the life sciences have not yet adopted the language of mathematics.

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Contributions to Embryology, Vol. XXXIV, Nos. 222 to 230. Carnegie Institution Publ. 592. Washington, D. C.: Carnegie Institution of Washington, 1951. 196 pp. and 58 plates. $9.50; $8.75 paper.

Eight of the nine papers in this new volume of *Contributions to Embryology* deal with primate material (macaque, 3; human, 5) and are equally divided between studies of embryonic development and of the reproductive tract. The ninth, by LaVelle, "A Study of Hormonal Factors in the Early Sex Development of the Golden Hamster," compares the effects of castration of hamsters of both sexes on day 1 after birth and of administration of male sex hormone with the conditions found in normally developing animals. The material in all the papers is presented in the lucid style and with the abundant and well-executed illustrations that have characterized papers in previous volumes.

The most extensive of the four embryological studies describes age groups XIX through XXIII in the series "Developmental Horizons in Human Embryos," planned by Streeter for the survey of the Carnegie Collection. This paper, the fifth by Streeter, was prepared for publication by Heuser and Corner utilizing illustrations and notes assembled by the author prior to his death in 1948. These age groups cover the last ten days of the embryonic period and have an estimated ovulation age of 39 ± 1 to 47 ± 1 days. Tabulated data concerning the 112 embryos, photographs of ones selected from each horizon, and detailed descriptions and figures of the development of the eye, cochlea, kidney, and certain other organs are presented. A graphic plot of embryos in the collection in horizons XI through XXIII provides a growth curve for the period between 22 and 48 days of estimated ovulation age.

Of the three other embryological studies, that by Hines and Emerson, "Development of the Spinal Cord in the Fetal and Infant Macaque, I. Growth, as Increase in Size," analyzes measurements of cord length and of cross-sectional areas at selected levels of the cord in specimens from 66 days of gestation to 14 months postnatally; that by Sensenig, "The

Early Development of the Meninges of the Spinal Cord in Human Embryos," traces meningeal origin to paraxial somitic mesoderm with a contribution of some neural crest cells to the pia mater; and that by Faulconer presents "Observations on the Origin of the Müllerian Groove in Human Embryos."

The four papers on the reproductive system include one on corpora lutea of the human ovary (White, Hertig, Rock, Adams); two on cyclic changes in the endometrium of the macaque (Bartelmez, with the collaboration of Corner and Heuser; Bensley); and one on certain differences in the pattern of uterine enlargement in primigravidae and multigravidae during the latter half of pregnancy (Reynolds and Baker). The report by White *et al.* compares histological and histochemical observations on 28 corpora lutea from pregnancies of 60 hours (a 2-celled egg) to 4½ months with those made on 48 corpora representing every day from ovulation to menstruation in normal menstrual cycles and on 13 associated with abnormal ova. "K cells," a new cell type, arising in the theca interna and eventually appearing in the membrana granulosa receive particular emphasis since their ketosteroid content suggests that they, as well as the granular lutein cells, may be involved in the secretory function of the corpora.

Two aspects of the cyclic changes in the macaque's endometrium are presented by Bartelmez and Bensley. The former considers the changes in the endometrium as a whole; the latter, the fluctuations in the mitotic activity of its epithelium. Both compare the conditions found in the different phases of the menstrual cycle (follicular, progravid, regressive, menstrual, and repair). Bensley finds the highest mitotic rate at the follicular phase and the lowest at the late luteal phase, but some variation in the rate appears in different regions of the epithelium, such as the surface epithelium, the superficial glands, and the basal glands. Bartelmez describes in detail the structural pattern of the endometrium for each phase and interprets the conditions found in the follicular, progravid, and regressive phases as adaptations for insemination, care of the blastocyst, and nourishment of the trophoblast.

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A Study of Antimetabolites. D. W. Woolley. New York: Wiley; London: Chapman & Hall, 1952. 269 pp. $5.00.

The establishment of a new principle in any branch of science occurs rarely. We can now safely assert, however, that the interference with metabolic activities by structural analogs is an established principle in biology. Its demonstration during the past 12 years has been more and more conclusive. (A number of investigators explained various phenomena on this basis as far back as 1920, it is interesting to note.)

This review of the antimetabolites by one of the foremost authorities in the field is most welcome and rewarding. Material covered includes a summary of the factual knowledge; hypotheses; applications to chemotherapy, pharmacology, and biochemistry; "the designing of antimetabolites;" and a chapter on synthesis and other phases of methodology.

The "favored hypothesis" for this phenomenon is that the antimetabolite is able to form a complex with the enzyme with which the metabolite normally reacts, but this enzyme-antimetabolite complex cannot then be converted into the normal products of the reaction, whereas the enzyme-metabolite complex can. This hypothesis, as well as objections to it, is examined critically.

It is not generally recognized that antimetabolites occur widely in nature and that evidently "nature long ago has seized upon this phenomenon, possibly as an elegant way of controlling natural processes." Cases in point are the antagonisms between testosterone and estrone, adenosine and cytidine, and between certain amino acids. Sometimes these result in physiological checks and balances, sometimes in disease.

Isosterism is considered, and an attempt is made to reconcile it with the favored hypothesis. This is the phenomenon that is quite the opposite to biological antagonism—i.e., the fact that two drugs closely related in chemical structure may have the same rather than antagonistic effects. Another mystery discussed is the fact that *p*-aminobenzoic acid, toward which the sulfa drugs are antagonistic, is itself a chemotherapeutic agent against rickettsial diseases.

An interesting topic is the antihistaminics as antimetabolites. One or two of the examples used require some stretch of the imagination in order to see them as analogs of histamine, but since they have been found to be effective clinically, the effort is worth making.

The lack of an author index is a minor fault that does not appreciably lessen the usefulness of this scholarly and readable volume.

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Adhesion and Adhesives. N. A. de Bruyne and R. Houwink, Eds. Houston-Amsterdam: Elsevier, 1951. 517 pp. $10.00.

The editors, assisted by a group of 14 specialists, have undertaken to cover in one volume a rather detailed survey of adhesives. Two main sections of the book deal, respectively, with the theoretical aspects of adhesion and with classes of materials generally useful as adhesives. A final chapter briefly describes adhesive testing.

The theoretical section summarizes efforts to relate phenomenological quantities—for example, those representing surface tension, interfacial energy as well as solubility and compatibility with molecular constants, as defined by dipole moment and group moment, dielectric constant, and the van der Waals' constants. Such efforts have so far led only to limited qualitative successes. The rheology of adhesives is

dealt with adequately, and the theoretical section concludes with a discussion of the complicated treatments encountered when dealing with stress analysis in joints.

The treatment of specific adhesive systems occupies the major portion of the book. Principal divisions are made between organic adhesives, inorganic adhesives and cements, rubbery adhesives, and soldered joints, with suitable subdivisions where appropriate. The materials discussed are representative—for example, animal glue, starches, synthetic resins, asphaltic bitumen, and sodium silicate are listed, but the list is by no means exhaustive. The emphasis upon the various materials appears to be only indirectly related to their commercial importance, or to the adhesion principles they exemplify.

Many of the adhesives described have received adequate treatment elsewhere. The present volume serves mainly to bring this work up to date, and to assemble in one place a variety of materials to be dealt with in their capacity as adhesives. Comprehensive bibliographies with each subject will enable the reader to pursue further any subject of choice.

The editors state that the theoretical portion of this work was circulated in advance to the authors who dealt with applications. This has undoubtedly led to some uniformity in viewpoint and treatment, but on the whole the terminology and discussion are those usually encountered in the several specialist fields. There are more than the usual number of typographical errors, as well as examples of unusual hyphenation practice. These shortcomings are neither serious nor misleading, and the book can be recommended for having made a worth-while contribution to its field.

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Scientific Book Register

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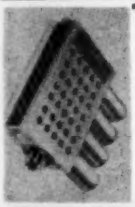

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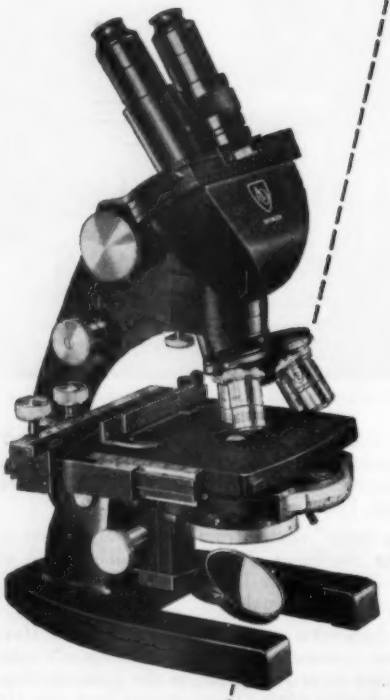

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